A COMPARATIVE STUDY OF EFFICACY OF STAPLERS VS HAND SEWN ANASTOMOSIS IN BOWEL SURGERIES

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CHENNAI

CERTIFICATE BY THE GUIDE AND THE HEAD OF THE DEPARTMENT

This is to certify that the dissertation entitled**“ A COMPARATIVE STUDY OF EFFICACY OF STAPLERS VERSUS HAND SEWN ANASTOMOSIS IN BOWEL SURGERIES ”** submitted by DR.K.ARUNSENTHILNATHAN to Tamilnadu Dr. M.G.R Medical University, Chennai, done in partial fulfillment of the requirement of the award of M.S Degree Branch – I (General Surgery) is a bonafide record work done, under my direct supervision and guidance, during the period of November 2017 to September 2018, in the Department of General Surgery, Madurai medical college.

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This is to certify that the dissertation entitled **"A COMPARATIVE STUDY OF EFFICACY OF STAPLERS VERSUS HAND SEWN ANASTOMOSIS IN BOWEL SURGERIES"**is a bonafide research work done by **DR.K.ARUNSENTHILNATHAN,**M.S. Postgraduate student in the Department of General Surgery, Madurai Medical College Madurai, under the guidance of **Dr.S.R.DHAMOTHARAN M.S.,** Professor and Head, Department of General Surgery, Madurai Medical College, GRH, Madurai in partial fulfillment of the requirements for the degree of M.S. in GENERAL SURGERY.

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DECLARATION BY THE CANDIDATE

I **DR.K.ARUNSENTHILNATHAN** solemnly declare that the dissertation titled**"A COMPARATIVE STUDY OF EFFICACY OF STAPLERS VERSUS HAND SEWN ANASTOMOSIS IN BOWEL SURGERIES"**is a bonafide and genuine research work carried out by me in the Department of General Surgery, Madurai Medical College, during the period of November 2017 to September 2018. I also declare that this bonafide work or a part of this work was not submitted by me or any other for any award, degree, diploma to any other University board either in India or abroad. This is submitted to The Tamilnadu Dr. M. G. R. Medical University, Chennai in partial fulfillment of the rules and regulation for the award of M.S.(General Surgery) Branch– I to be held in April 2019

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TABLE

INTRODUCTION

The word anastomosis comes from the Greek “ana” – without, and “stoma” - a mouth, reflecting the join of a tubular viscus (bowel) or a vessel, after resection or a bypass procedure[1]. Bowel anasomosis is a common procedure done in both elective as well as emergency gastrointestinal surgeries. It establishes a communication between the formerly two different portions of the intestine[2].

Bowel anastomosis can be done either by :

(1) Hand sewn method,

(2) Mechanical staplers,

(3) Fibrin glue[2].

The method of anastomosis chosen, either hand sewn or stapler depends on the surgeons preference, his/her technical skills, individual experience and the availability of equipments. The theory behind creating a safe and a healthy bowel anastomosis remains constant, irrespective of the technique chosen.

Anastomosis can be either :

(1) End to end,

(2) Side to side,

(3) End to side.

Various studies have been conducted to compare the efficacy of

staplers and hand sewn anastomosis. This study compares the efficacy between the two, in respect to various parameters, which are discussed in the forthcoming headings.

HAND SEWN METHOD

Prior to the nineteenth century, intestinal surgery was limited to exteriorization by means of either a stoma or closure of simple lacerations. Lembert then described his seromuscular suture technique for anastomosis in 1826, while Dr.Senn advocated a two – layer technique for closure[1].

Kochers method utilized a two layer anastomosis. The first layer is a continuous all layer (full thickness) suture using catgut. The second layer is a continuous or interrupted seromuscular suture using silk, this method became the mainstay of bowel anastomosis for years[1].

Halsted then favoured a single layer extramucosal suture, and this was subsequently advocated by Matheson, as it was thought to cause the least tissue necrosis or luminal narrowing. This technique has now become widely accepted, although it is essential that this is not confused with aseromuscular suture technique. The extra mucosal suture must include the submucosa, because this has a high collagen content and is the most stable suture layer in all sections of the gastrointestinal tract[1].

Various prospective randomized trials were conducted comparing the single layer vs two layer anastomosis and concluded that there is probably a little or no difference in the outcome, provided the basic principles of intestinal anastomosis should be followed strictly in every steps of the procedure.

MECHANICAL STAPLING DEVICES

Mechanical stapling devices were first used successfully by Humer Hultl in Hungary in 1908, who was rightly called " the father of surgical staple " to close the stomach after resection .Hultl's prototype stapler weighed 8 pounds (3.6 kg), and required two hours to assemble and load[3]. Today there are wide range of mechanical stapling devices that can be used both in open surgeryand also laparoscopically. Various types of mechanical stapling devices include :

(1) Circular end to end anastomosis stapler (EEA),

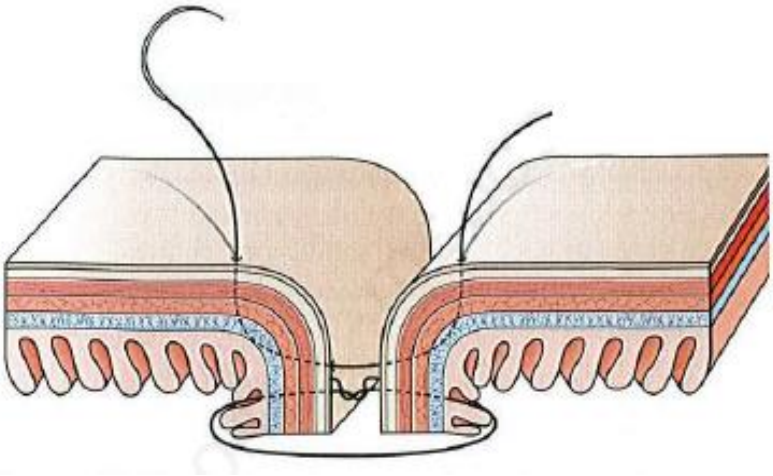
(2) Linear cutter (side to side) stapler (GIA),

(3) Transverse anastomosis stapler (TA),

(4) Endoscopic stapling device (endo GIA gun).

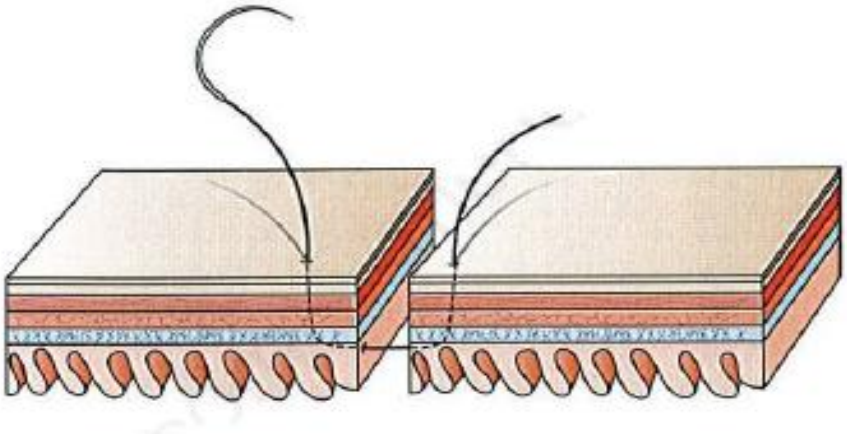
Nowadays staplers are made of Titanium, loaded into disposable cartridges.Titanium staples are not suspected of causing nickel reactions, because nickel is rarely if ever used in titanium alloys.Also, Titanium produces less reaction with the immune system and, being non-ferrous, does not interfere significantly with MRI scanners.

METHODS OF HAND SEWN ANASTOMOSIS



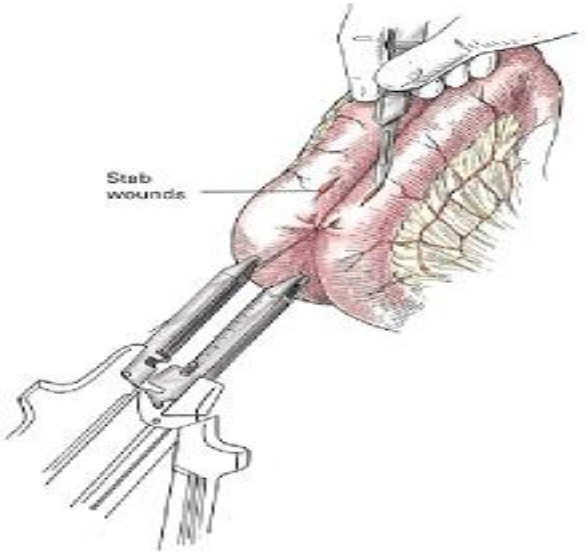
Kochers two-layer anastomosis : First layer – full thickness, continuous suture

Second layer – interrupted, sero-muscular stitch.

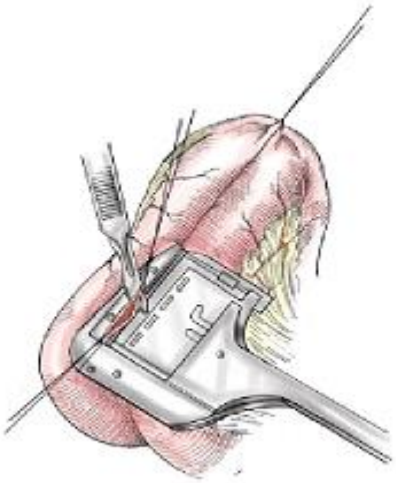


Single layer extra-mucosal technique of anastomosis

STAPLER ANASTOMOSIS



(1) Side to side anastomosis using linear cutter stapler



(2) Anastomosis using the transverse anastomosis stapler

AIM OF THE STUDY

To study and compare the effectiveness of staplers vs hand sewn anastomosis in gastro-intestinal surgeries in patients admitted at Govt.Rajaji hospital, Madurai.

PRIMARY OBJECTIVES

To derive conclusions about the advantages of staplers over conventional hand sewn anastomosis, in respect to the following paremeters :

(i) Time taken for the procedure,

(ii) Time taken for the bowel sounds to return,

(iii) Resumption of oral feeds,

(iv) Post operative hospital stay,

(v) Incidence of complications :

- Anastomotic bleed,
- Anastomotic leak,
- Anastomotic stricture.

REVIEW OF LITERATURE

SURGICAL ANATOMY OF THE SMALL AND LARGE INTESTINE[4,5] :

Small intestine :

Small intestine extends from the pylorus upto the ileo-caecal junction. It is about 6 meters long and is divided into :

(1) An upper fixed part, the duodenum.

(2) A lower mobile part – jejunum and ileum, forming a very long convoluted tube.

Duodenum :

The duodenum is situated in the epigastric and umbilical regions. It is a C-shaped structure that extends from the stomach around the head of the pancreas to join the jejunum. It is about 25 cm long and is further divided into four parts :

(1) The first (or) superior part – 2 inches long,

(2) The second (or) descending part – 3 inches long.

(3) The third (or) horizontal part – 4 inches long.

(4) The fourth (or) ascending part – 1 inch long.

Duodenum is mostly a retro-peritoneal structure and fixed, except at

its two ends where it is suspended by folds of peritoneum, and is therefore mobile.

The interior of the second part of duodenum contains :

(1) Major duodenal papilla, which is an elevation present posteromedially 8 to 10 cm distal to the pylorus. The hepato-pancreatic ampulla opens at the summit of the papilla,

(2) Minor duodenal papilla, which is present 6 to 8 cm distal to the pylorus and represents the opening of the accessory pancreatic duct.

Regarding the arterial supply,the upper half is supplied by the superior Pancreatico-duodenalartery, a branch of the gastro-duodenal artery.The lower half is supplied by inferior pancreatico-duodenal artery, a branch of the superior mesenteric artery.Venous drainage is throughthe superior pancreatico-duodenal vein, which drains into the portal vein, and the inferiorpancreatico-duodenal vein joins the superiormesenteric vein.

Ligament of Treitz :

It is also known as " suspensory muscle of the duodenum ". This is a fibromuscular band which suspends and supports the duodeno-jejunal flexure. It is made up of :

(1) Striped muscle fibres in its upper part,

(2) Elastic fibres in its middle part,

(3) Plain muscle fibres in its lower part.

It arises from the left crus of the diaphragm, then passes downwards and gets attached to the posterior surface of the duodeno-jejunal flexure and the junction of third and fourth parts of duodenum.

Jejunum and ileum :

Jejunum and ileum are suspended from the posterior abdominal wall by the mesentery and therefore have considerable mobility. Jejunum constitutes the upper two-fifths of the mobile part of the small intestine, while ileum constitutes the lower three fifths.The coils of the jejunum occupy the upper left partof the abdominal cavity, whereas the ileum tends to occupythe lower right part of the abdominal cavity and the pelviccavity.

Jejunum begins at the duodeno-jejunal flexure while the ileum terminates at the ileo-caecal junction. Intestinal villi are finger like projections of the mucus membrane. They are simply visible to the naked eye. They give the surface of the intestinal mucosa, a velvety appearance. They are large and numerous in the duodenum and jejunum, but are smaller and fewer in ileum. They increase the surface area of the small intestine by about eight times. Intestinal absorptive cells, goblet exocrine cells, Paneth cells, T-cells and APUD (amine precursor uptake and decarboxylation) cells are found in the intestinal villi. They play both absorptive as well as other functions.The substances absorbed by the small bowel include water, ions, and nutrients (carbohydrates, proteins, fats, vitamins and minerals).

The rapid turnover of the epithelium of the mucosa of small bowel (in comparison with the slow turnover of that in the large bowel) makes neoplasia of the small bowel unusual. The following factors may explain why the small bowel has fewer tumor incidence in comparison with the stomach and large bowel:

(i) The mucosal cells are replaced rapidly

(ii) Small bowel chyme has high liquid content and is, therefore, less "irritating" .

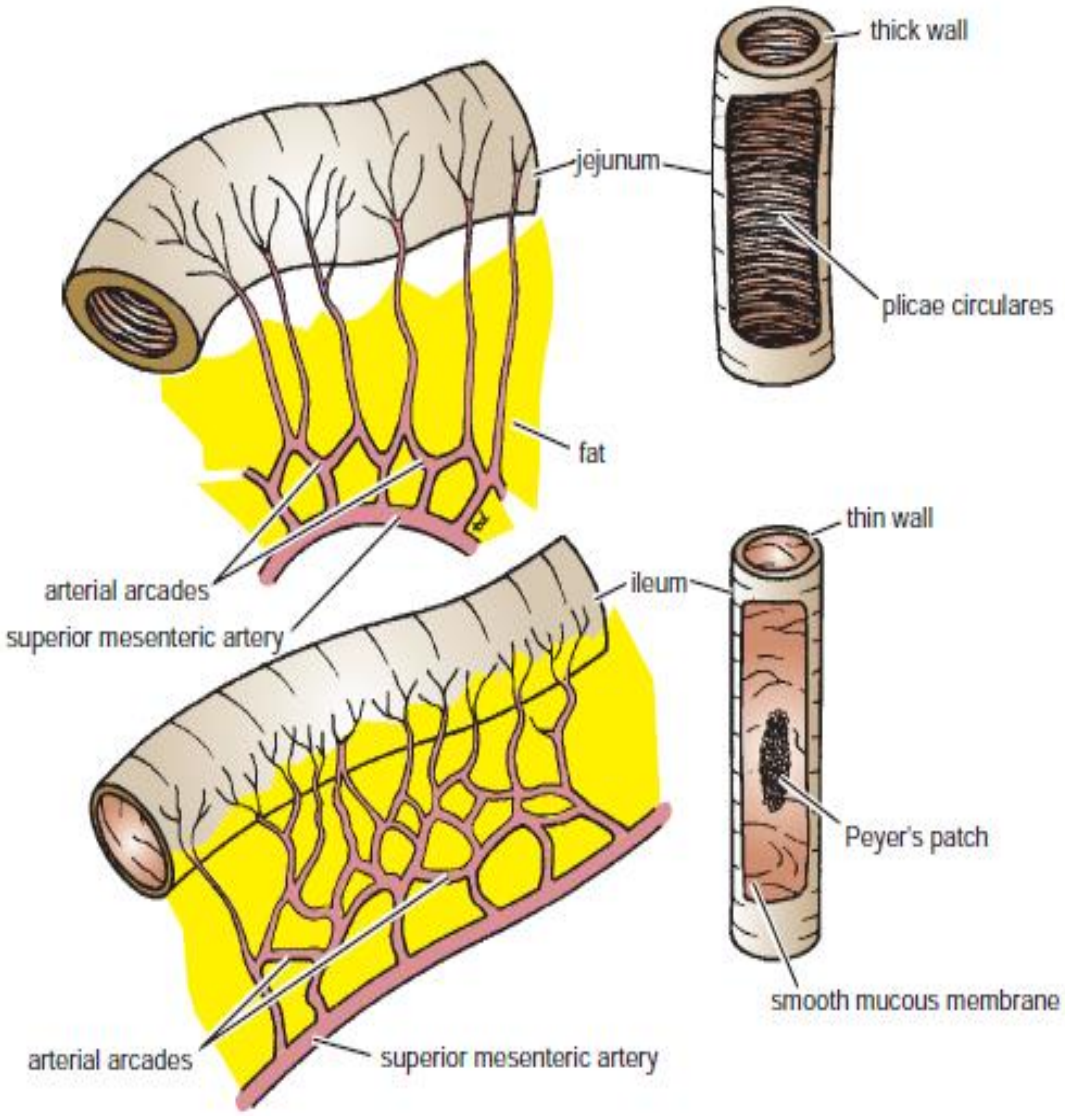
(iii) Contents move rapidly through the small bowel, thus minimizing exposure to carcinogens.

(iv) High activity of the enzyme benzopyrene hydroxylase in the small intestinal mucosa results in detoxification of carcinogens.

(v) The small intestine,offers both humoral and cellular immune surveillance (secretory IgA, abundant immunocompetent lymphoid tissue).

Because of its extent and position, the small intestine is commonly damaged by trauma.The presence of the vertebral columnand the prominent anterior margin of the 1st sacral vertebra mayprovide a firm background for intestinal crushing in cases of midlinecrush injuries.

DIFFERENCES BETWEEN JEJUNUM AND ILEUM



DIFFERENCES BETWEEN JEJUNUM AND ILEUM [4]

FEATURE	JEJUNUM	ILEUM
1) LOCATION	Occupies the upper and left side of the intestinal area.	Occupies the lower and right side of the intestinal area.
2) WALLS	Thicker and more vascular.	Thinner and less vascular.
3) LUMEN	Wider and often empty.	Narrower and often loaded.
4) MESENTERY	- Windows are present, - Less abundant fat, - One or two arterial arcades, - Vasa recta are longer and fewer.	- Windows are absent, - More abundant fat, - Three or six arterial arcades, - Vasa recta are shorter and more numerous.
5) CIRCULAR MUCOSAL FOLDS	Larger and more closely set.	Smaller and sparse.
6) VILLI	Large, thick and leaf-like and more abundant.	Shorter, thinner and finger-like and less abundant.
7) PEYERS PATCHES	Absent	Present
8) SOLITARY LYMPHATIC FOLLICLES	Fewer	More numerous

LARGE INTESTINE[4] :

Large intestine extends from ileo-caecal junction upto the anus. It is about 1.5 metres long and is divided into :

(1) Caecum,

(2) Ascending colon,

(3) Right colic (hepatic) flexure,

(4) Transverse colon,

(5) Left colic (splenic) flexure,

(6) Descending colon,

(7) Sigmoid colon,

(8) Rectum,

(9) Anal canal.

The structure of the large intestine is adapted for storage of matter reaching it from the small intestine and for the absorption of fluid and solutes from it. The relevant features of large intestine are :

(1) Large intestine is wider in caliber than the small intestine. The caliber is greatest at its commencement (caecum) and gradually diminishes towards the rectum, where it is dilated to form the rectal ampulla, just above the anal canal.

(2) The greater part of the large intestine is fixed, i.e., retro-peritoneal. These are – caecum, ascending and descending colon, and the rectum.

(3) The mobile parts of large intestine, i.e., intra-peritoneal structures are – transverse colon and sigmoid colon.

(4) The longitudinal muscle coat forms three ribbon – like bands called "taenia coli". These are :

Taenia libera – anterior,
Taenia mesocolia – posteromedial,
Taenia omentalis – posterolateral.

In transverse colon, taenia libera is placed inferiorly, while in all other parts, it is placed anteriorly.

(5) Small bags of peritoneum filled with fat, called "appendices epiploicae" are scattered over the surface of the large intestine, except for the appendix, caecum and the rectum.

(6) Lymph from the large intestine passes through four sets of lymph nodes. These are :

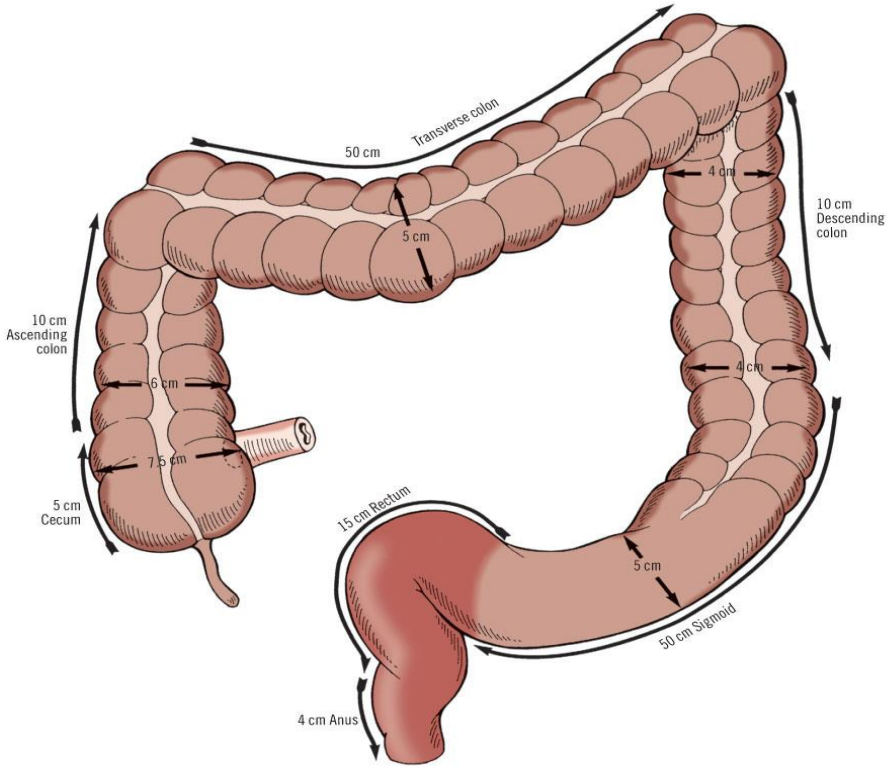
Epicolic nodes – lies along the surface,

Paracolic nodes – lies on the medial side of the ascending and the descending colon and near the mesocolic border of the transverse colon and the sigmoid colon.

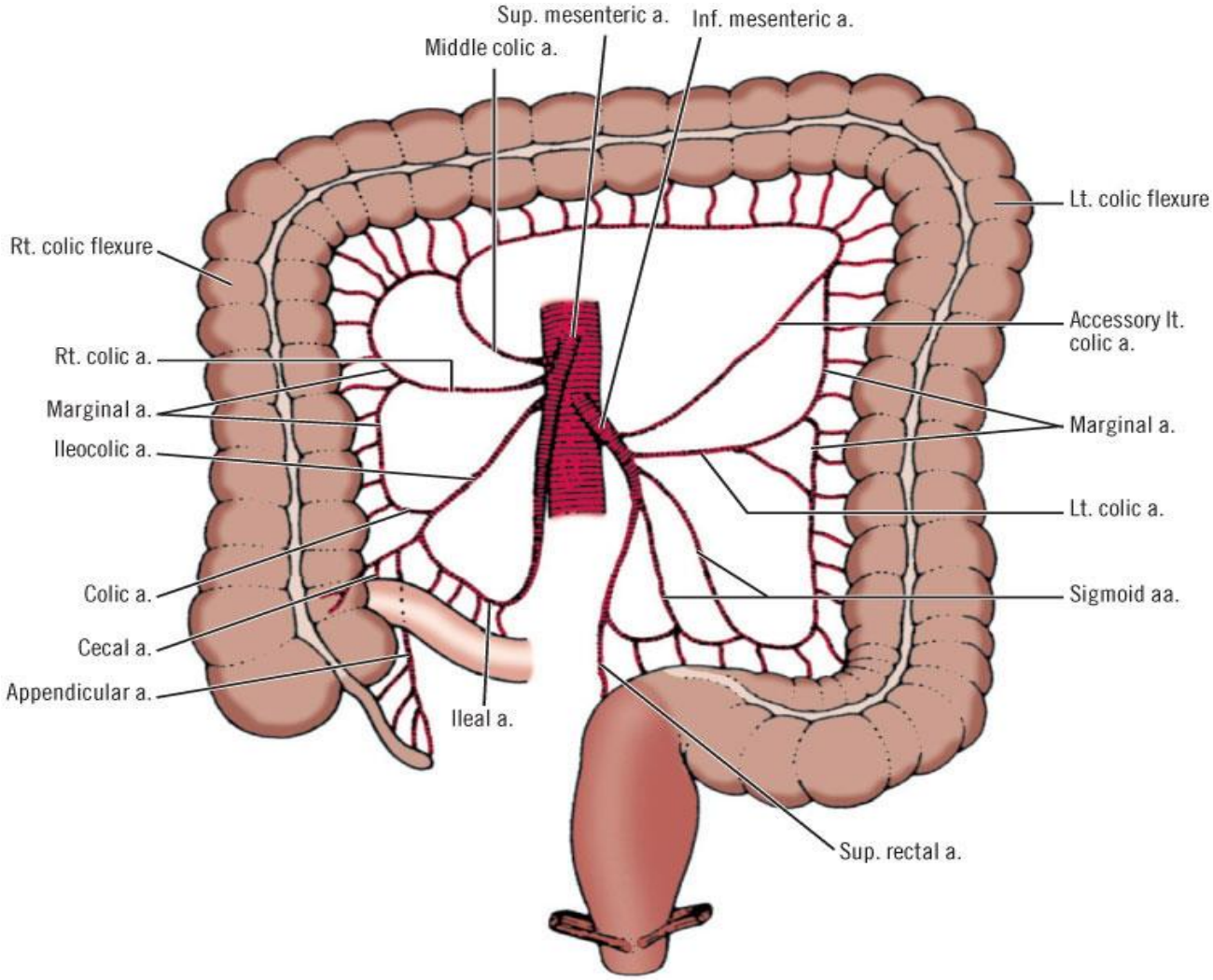
Intermediate nodes – lies along the branches of major vessels.

Terminal nodes – lies along the superior and inferior mesenteric vessels.

PARTS OF LARGE BOWEL



BLOOD SUPPLY



DIFFERENCES BETWEEN SMALL AND LARGE INTESTINE[4]

FEATURE	SMALL INTESTINE	LARGE INTESTINE
(1) APPENDICES EPIPLOICAE	Absent	Present
(2) TAENIA COLI	Absent	Present(3 in number)
(3) SACCULATIONS	Absent	Present
(4) LENGTH	6 meters	1.5 meters
(5) DISTENSIBILITY & DIAMETER	Less distensibility & less diameter.	More distensibility & more diameter.
(6) FIXITY	Greater part of the small intestine is freely mobile.	Greater part of the large intestine is fixed.i.e., retro-peritoneal.
(7) VILLI	Present. More in jejunum than ileum.	Absent
(8) TRANSVERSE MUCOSAL FOLDS	Permanent .	Obliterated, when the longitudinal muscle coat relaxes.
(9) PEYERS PATCHES	Present in ileum.	Absent.

BLOOD SUPPLY[4,5]

Blood supply is from the branches of the superior mesenteric and inferior mesenteric vessels.

Arterial supply:

Superior mesenteric artery

It is a single vessel arising anteriorly from the abdominal aorta at the level of L1, usually just below the coeliac trunk. It courses anteroinferiorly, behind the neck of the pancreas and splenic vein, crossing anterior to left renal vein. It then emerges anterior to the uncinate process of the pancreas and crosses anterior to the third part of the duodenum. It enters the upper portion of the small bowel mesentery and runs along the root of the mesentery down to the right. Branches to the jejunum and the ileum are given off to the left, and branches to the proximal and mid colon are given off to the right.SMA terminates at the ileum where it anastomoses with the ileal branch of the ileocolic artery.

Branches are

(1) On the right side:

(i) *Inferior pancreatico-duodenal artery:* supplies the head of the pancreas and the duodenum.

(ii) *Middle colic artery:* Has right and left branches. Right branch anastomoses with right colic artery, while the left branch anastomoses with the left colic artery.

Right hemicolectomy means resection of terminal ileum and a portion of large intestine upto the area supplied by the branches of the middle colic artery. It is done for growth in caecum /ascending colon.

Extended right hemicolectomy means resection upto the area supplied by left branch of middle colic artery. Done for the growths in the hepatic flexure.

(iii) *Right colic artery:* Has an ascending branch which anastomoses with right branch of middle colic artery and a descending branch, which anastomoses with ileocolic artery. It supplies upper 2/3rd of ascending colon and hepatic flexure.

(iv) *Ileo-colicartery :* It supplies the terminal ileum ,caecum, appendix and lower 1/3rd of ascending colon.

i) On the left side:

i) *Jejunal and ilealbranches* : These are about 12 to 15 in number and runs between the two layers of the mesentery. They anastomose with each other to form arterial arcades which give off straight branches or vasa recta to the gut. In jejunum the vasa recta are longer, widely spaced and less in number, while in ileum they are shorter, closely spaced and less numerous.

Inferior mesenteric artery

It supplies left 1/3rd of transverse colon, descending colon, sigmoid colon, rectum, upper part of anal canal above the anal valves. Branches are

i) *Left colic artery*: Has an ascending branch which anastomose with left branch of middle colic artery and a descending branch which anastomose with sigmoid artery. It supplies left 1/3rd of transverse colon and descending colon.

ii) *Sigmoid artery*: These are 2 to 4 in number and supplies lower portion of descending colon and sigmoid colon.

iii) *Superior rectal artery*: It is the terminal branch of inferior mesenteric artery. It supplies the lower portion of sigmoid colon and upper 1/3rd of rectum.

Marginal artery of Drummond[6]

It is composed of series of anastomosing arcades between the branches of ileocolic, right colic, middle colic, left colic and sigmoid arteries. These form a single looping vessel. Marginal artery courses roughly parallel with the mesenteric border of large intestine, 1 to 8 cm from the intestinal wall. Numerous vasa recta arise from the marginal artery to supply the colon. Marginal artery is capable of supplying the colon, even in the absence of one of the main feeding trunks.

Arc of Riolan[6]

It is also known as the mesenteric meandering artery (of Moskowitz) or central anastomotic mesenteric artery, is an arterio-arterial anastomosis between the superior and inferior mesenteric arteries. It is an inconstant artery that connects proximal superior mesenteric artery or one of its

primary branches to the proximal inferior mesenteric artery or one of its primary branches. It is classically described as connecting the middle colic branch of SMA with the left colic branch of the IMA. It forms a short loop, that runs close to the root of the mesentery.

When present, the arc of Riolan is an important connection between SMA and IMA in the setting of arterial occlusion or significant stenosis. In proximal SMA occlusion, Arc of Riolan provides collateral flow from the IMA to the SMA territory, and vice versa. In distal abdominal aortic occlusion, it provides collateral flow from the SMA to IMA to iliac vessels (via superior rectal artery) and then to the lower limbs (via external iliac artery).

Venous Drainage:

Venous drainage is through superior and inferior mesenteric veins. The tributaries accompany the corresponding branches of arteries.

MESENTERY[4,5]

It is a broad, fan-shaped fold of peritoneum, which suspends the coils of jejunum and ileum, from the posterior abdominal wall. The root of the mesentery is 15 cm long and is directed obliquely downwards and to the right. It extends from the duodeno-jejunal flexure on the left side of second lumbar vertebra to the upper part of right sacro-iliac joint.

From its course, it crosses the following structures :

(1) The third part of duodenum, where the superior mesenteric vessels enter into it,

(2) Abdominal aorta,

(3) Inferior venacava,

(4) Right ureter,

(5) Right psoas major.

The free (or) intestinal border is approximately 6 meters long, and is thrown into multiple pleats. The breadth of the mesentery is about 20 cm in the central part, but gradually diminishes towards both the ends.

The contents of the mesentery are :

(1) Jejunal and ileal branches of superior mesenteric artery,

(2) Accompanying veins,

(3) Lymphatics,

(4) Connective tissue,

(5) Fat,

(6) Autonomic nerve plexuses.

Transverse mesocolon:

This is a broad fold of peritoneum which suspends the transverse colon from the upper part of the posterior abdominal wall. It contains middle colic vessels and lymphatics of transverse colon.

Sigmoid mesocolon :

This is a triangular fold of peritoneum which suspends the sigmoid colon from the pelvic wall. This contains sigmoid vessels, superior rectal vessels, nerves and lymphatics of sigmoid colon.

COMPARTMENTS OF PERITONEUM[5]

Peritoneal cavity can be divided into two major compartments by an imaginary cross-sectional plane that passes through the transverse mesocolon. These are:

i) ***Supra-colic compartment***, which is further divided into right and left supra-hepatic(sub diaphragmatic) spaces and right and left infra hepatic(sub-hepatic) spaces.

Supra hepatic space - This potential space is divided into right and left spaces by the falciform ligament. Right suprahepatic space lies between the diaphragm and the anterosuperior surface of the right lobe and the medial segment of the left lobe of the liver. Medial boundary is the falciform ligament. Here the serous surfaces of the liver and the diaphragm are in apposition, with a potential space in between. This potential space may become the site of intraperitoneal fluid collection and

suprahepatic (subphrenic) abscesses.The corresponding supra-hepatic space on the left is between diaphragm and the superior surface of the lateral segment of the left lobe of the liver and the fundus of the stomach.

Infrahepatic Space – It is further divided into right and left infrahepatic spaces.The right infrahepatic space, also known as "subhepatic space, hepatorenal space, Pouch of Morison" is bounded superiorly and anteriorly by the right lobe and the medial segment of the left lobe of the liver and the gallbladder, and superiorly and posteriorly by the posterior layer of the coronary and right triangular ligament. Inferiorly, this space opens into the general peritoneal cavity and is partly bounded by the hepatic flexure of the colon and the transverse mesocolon and, medially, by the hepatoduodenal ligament. The left infrahepatic space is divided into asmall antegastric space and the larger lesser sac of the peritoneum.

ii) ***Infra-colic compartment***, which contains right and left paracolic gutters, right infra-colic(supra mesenteric) compartment, left infracolic(inframesenteric) compartment and the pelvic cavity. They are located on the lateral and the medial sides of ascending and descending colon. The right lateral para-colic gutter communicates freely with the right posterior subphrenic space. Therefore, the pelvic fluid can reach the diaphragm and fluids from the upper abdomen can drain into the pelvic cavity. The left lateral paracolic gutter does not communicate with the peri-splenic areas and the left subdiaphragmatic space.

CONDITIONS REQUIRING RESECTION AND ANASTOMOSIS[5]

Benign:

i) Polyps

ii) Intussusception

iii) Mesenteric ischemia

iv) Intestinal obstruction due to various causes.

v) Traumatic lacerations that are not amenable for primary suturing.

Malignancies of GI tract

Non pathologic bowel condition:

i) Ileal conduit creation after radical cystectomy

ii) As intestinal loops for esophageal reconstruction.

iii) Ureteroileo-sigmoidostomy.

iv) Ileal pouch formation and ileo-anal anastomosis.

v) As mucosal graft of jejunum for large duodenal defects.

vi) as intestinal transplant for chronic short gut syndrome following surgical intervention for necrotizing enterocolitis.

vii) as segments of intestine for biliary tract surgery.

viii) Strictureplasty for obstructing small bowel Crohn's disease.

INTESTINAL OBSTRUCTION[1]

Intestinal obstruction can be classified into two types :

(1) Dynamic obstruction,

(2) Adynamic obstruction.

1) ***Dynamic obstruction[1]:***

Here peristalsis is working against a mechanical obstruction. Irrespective of the aetiology, the bowel proximal to the obstruction dilates while the bowel that is distal to the obstruction becomes empty and eventually collapses. Initially there will be an increased peristalsis in an attempt to overcome the obstruction. If the obstruction is not relieved, the proximal bowel continues to dilate, ultimately there will be a reduction in peristalsis, eventually resulting in flaccidity and paralysis.

The proximal bowel loop distension is caused by two main factors – gas and fluid. Gas production is due to significant overgrowth of both aerobic and anaerobic organisms. The majority is made up of nitrogen (90%) and hydrogen sulphide. The fluid contains various digestive juices such as saliva, gastric and pancreatic juices. As the absorption from the obstructed gut is retarded, there will be accumulation of these substances inside the gut lumen. Dehydration and electrolyte imbalance occurs due to :

- decreased oral intake,
- impaired intestinal absorption,
- vomiting,

- transudation of the fluid into the peritoneal cavity,

- sequestration of fluid within the bowel lumen.

Examples for dynamic obstruction are :

1) *Intraluminal*[1]:
    - Fecal impaction
    - Foreign bodies
    - Bezoars
    - Gall stones
    - Meconium ileus

2) *Intramural*[1]:
    - Stricture
    - Malignancy
    - Volvulus
    - Intussusception
    - Hematoma
    - Radiation enteritis

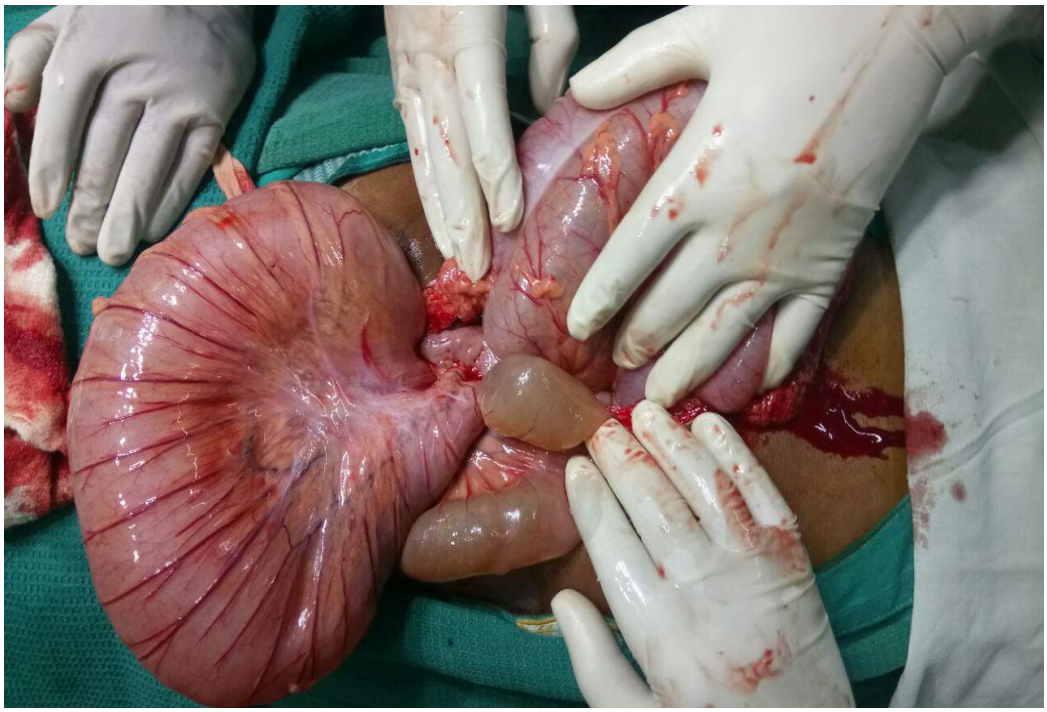
3) *Extramural*[1]:
    - Bands/ adhesions
    - Hernias (most common cause)
    - Intra-abdominal aneurysms.

Adynamic obstruction[1]:

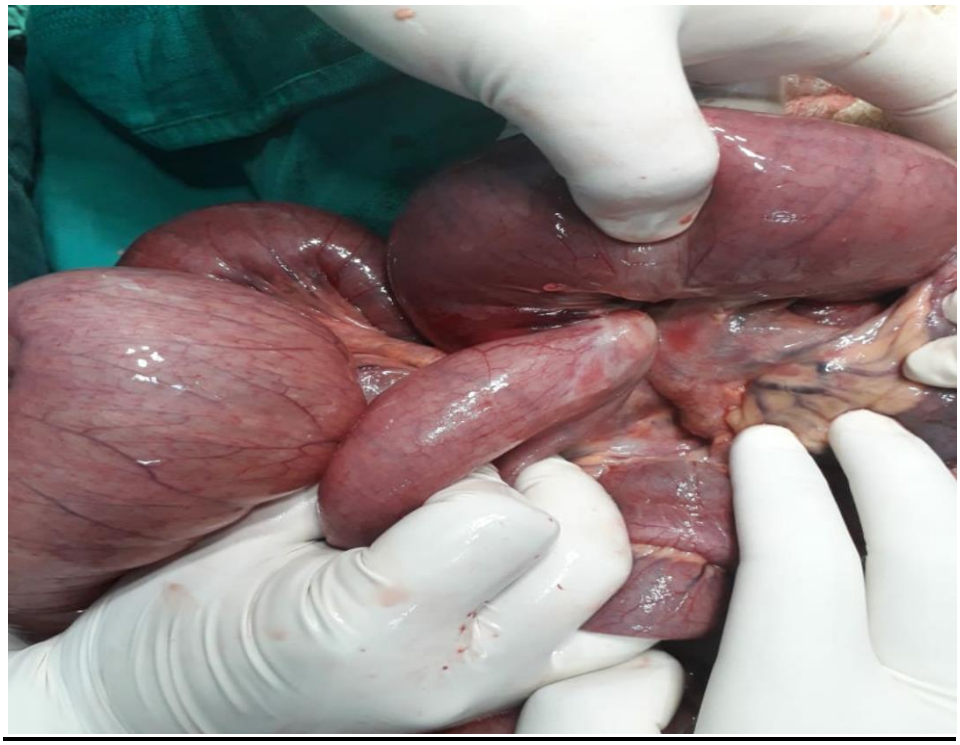
Here there is no mechanical obstruction. Peristalsis is absent or inadequate or even absent. Examples are :

- Paralytic ileus
- Pseudo-obstruction.

A CASE OF SIGMOID VOLVULUS CAUSING ACUTE INTESTINAL OBSTRUCTION



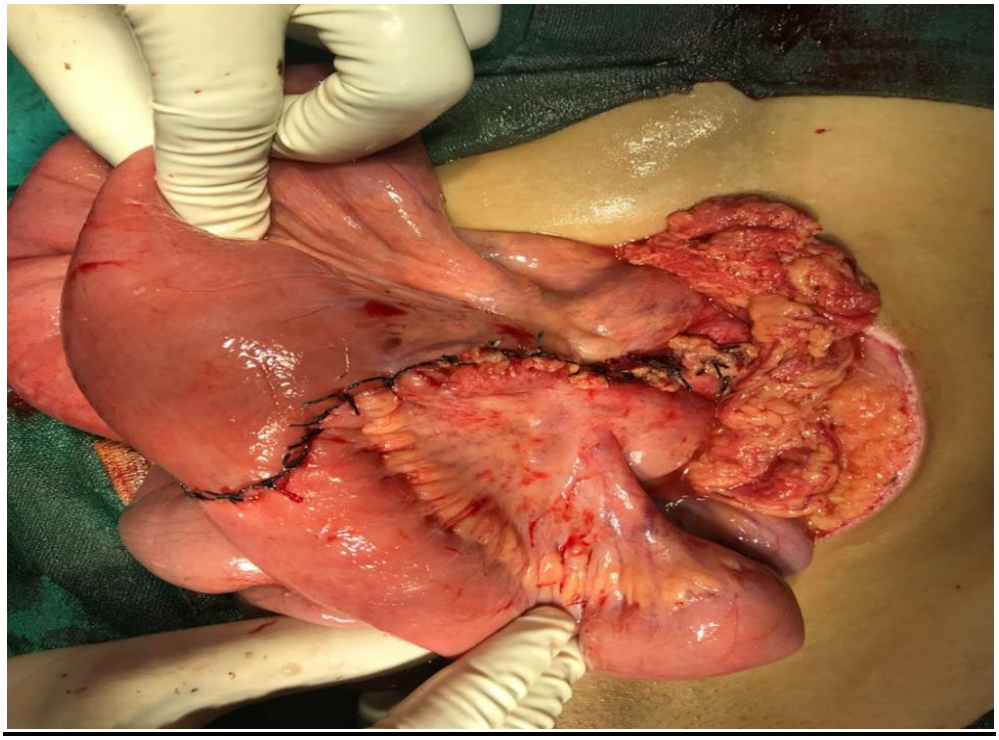
A CASE OF INTUSSUSCEPTION CAUSING ACUTE INTESTINAL OBSTRUCTION



LEAD POINT IN THIS CASE – POLYP

AFTER COMPLETION OF RESECTION

TWO LAYERED HAND SEWN END TO END ANASTOMOSIS



Pathophysiology[7]

Increased pressure within the bowel wall as a result of obstruction.

↓

Compromises venous return

↓

Congestion and edema of bowel wall (bowel wall turns purple)

↓

Jeopardizes arterial supply

↓

Blackish discoloration of bowel with loss of peristalsis

↓

Gangrene

↓

Perforation of bowel

↓

Translocation and systemic exposure to anaerobes and endotoxins

↓

Peritonitis and septicemia

Closedloop obstruction[1]

This type of obstruction occurs when the bowel is obstructed at both the proximal and at distal points.This distension is principally confined to the“closed loop”. Distension proximal to the is obstructed segment, isnot typically marked.A

classic form of the closed loop is seen in the presence of a malignant stricture of colon with a competent ileo-caecal valve (present in up to one -third of the individuals).This can occur with the lesions as far distally as the rectum .The inability of the distended colon to decompress itself into small bowel results in an increase in intra-luminal pressure ,which is greatest at the caecum ,with subsequent impairment of blood flow in the wall. If unrelieved, this results in necrosis and perforation.

CLOSED LOOP OBSTRUCTION

SMALL BOWEL OBSTRUCTION VS LARGE BOWEL OBSTRUCTION[7]

FEATURE	PROXIMAL SMALL BOWEL	DISTAL SMALL BOWEL	LARGE BOWEL
(1) SITE	Duodenum and jejunum	Ileum	Anywhere along the large bowel.
(2) CAUSES	- Congenital - Lipomas - Leiomyomas - Malignancy - Bands and adhesions	- Tuberculous strictures - Malignancy - Crohn's disease - Gallstones - Hernias - Roundworm - Congenital	- Malignancy - Tuberculous stricture - Anorectal malformation - Volvulus - Congenital megacolon - Bands
(3) CLINICAL FEATURES	Severe vomiting, dehydration, minimal or less distension, colicky pain.	Central distension, vomiting, dehydration central abdominal pain.	Constipation and distension occurs Early, vomiting occurs late. Less pain.
(4) X-RAY FEATURES	Valvulae conniventes are present.	Usually characterless. Central air-fluid level.	Haustrations are present.

Clinical features[1]

The clinical features may vary according to;

1) location of the obstruction;

2) duration of the obstruction;

3) underlying pathology;

4) presence or absence of intestinal ischemia.

Presentation will be further influenced by whether the obstruction is;

* Simple - in which the blood supply is intact;

* Strangulating / strangulated - in which there is interference to the blood flow.

The cardinal features of acute obstruction are :

(1) Abdominal pain – sudden, severe and colicky pain, usually centered around the umbilicus in small bowel obstruction, whereas in large bowel obstruction, it is usually over the lower abdomen. The pain coincides with peristaltic activity.

(2) Abdominal distension – in small bowel obstruction, the degree of distension depends on the site of the obstruction – more distal the lesion, the more will be the distension. In colonic obstruction, distension is a late feature.

(3) Vomiting – the more distal the lesion, longer the interval between the onset of symptoms and the appeatrance of nausea and vomiting. As the obstruction progresses, the character of the vomitus changes from the digested food to the faecal material, due to the presence on enteric bacterial overgrowth.

(4) Constipation – this may be further classified as sbsolute

constipation, where neither flatus nor faeces is passed, and relative constipation, where only the flatus is passed. Absolute constipation is the cardinal feature of complete intestinal obstruction. This type of absolute constipation does not apply to :

- Richters hernia,
- Gallstone ileus,
- mesenteric ischaemia,
- functional bowel obstruction, assosciated with pelvic abscess,
- all cases of partial obstruction.

The other manifestations of intestinal obstruction that may be encountered include

(5) dehydration,

(6) abdominal tenderness – any localized tenderness implies the ongoing ischaemia, whereas the presence of diffuse tenderness all over the abdomen implies the development of perforation / peritonitis.

(7) Hyperpyrexia,

(8) Visible gastric / intestinal peristalsis (VGP / VIP).

(9)Bowel sounds – high pitched sounds are indicative of acute intestinal obstruction, whereas in longstanding obstruction, the peristalsis becomes scanty or even absent.

(10) hypokalemia,

(11)leucocytosis,

(12)oliguria,

(13) hypovolemic shock ,

(14) septicaemia,

(15)respiratory distress and

(16) peritonism.

In all cases of suspected intestinal obstruction,the hernial orifices must be examined.

Investigations

(1) complete hemogram – may show increased hematocrit level,

(2) leucocytosis,

(3) rise in BUN and serum creatinine,

(4) plain x- ray abdomen erect – shows the following features :

* Multiple air – fluid levels. These are prominent in the erect film. In adults, two inconstant fluid levels, one at the duodenal cap and another at the terminal ileum are said to be normal. Air – fluid levels is said to be significant, if it is more than three in number. In small bowel obstruction, the number of air – fluid levels is directly proportional to the degree of the obstruction, and also to the site, more air – fluid levels as the lesion advances distally.

* Proximally dilated and the distally collapsed bowel loops.

* Jejunum – characterized by "valvulae conniventes" that appears as "concertina / ladder effect".

* Ileum – featureless loops.

* Caecum – if distended, produces a rounded gas shadow in the right iliac fossa.

* Large bowel other than caecum – shows haustral folds.

(5) USG abdomen and pelvis – shows the following features in acute obstruction :

* Dilated bowel loops,

* To and fro peristalsis or absent peristalsis.

* fluid-filled distended bowel with extraluminal free fluid between the bowel loops.

(6) CT abdomen and pelvis – often confirmatory. Signs of strangulation in CT scan are :

* reduced bowel wall enhancement.

* absence of mesenteric fluid.

Closed-loop obstructions are diagnosed when a bowel loop of variable length, is occluded at two adjacent points along its course. It may be partial or complete with characteristic features:

* radial distribution of several dilated fluid-filled bowel loops,

* stretching of prominent mesenteric vessels, converging towards the point of torsion.

* U-shaped or a C-shaped configuration.

* *Beak sign,* at the site of fusiform tapering.

* *Whirl sign,* reflecting the rotation of , bowel loops around a fixed point.

Features of strangulation are non-specific and include:

* thickened and increased attenuation of the bowel wall.

* halo sign or target sign.

**** pneumatosis intestinalis.***

* Presence of portal venous gas.

* localised fluid, or haemorrhage in the mesentery.

Management[7]

There are three main measures used in the management of acute intestinal obstruction. These includes :

(1) Nil per oral and gastro-intestinal drainage, via the nasogastric tube.

(2) Fluid and electrolyte replacement.

(3) Relief of obstruction.

Initially the resuscitative measures should be started first, followed by appropriate surgical intervention. Surgical measures include :

* Management of the segment at the site of obstruction,

* Management of the distended proximal bowel,

* Identification and correction of underlying cause of the obstruction.

In cases of small bowel obstruction, the first approach is to deliver the distended small bowel into the wound. This allows us to access the site of obstruction.The bowel should be covered with warm pads and the weight of the fluid filled bowel should be supported, so that the blood supply to the mesentery is not impaired. The underlying pathology such as bands / intussusception / volvulus etc. should be identified and the obstruction should be relieved.

Following the relief of the obstruction, viability of the involved bowel should be carefully assessed. Differences between the viable and the non-viable bowel are :

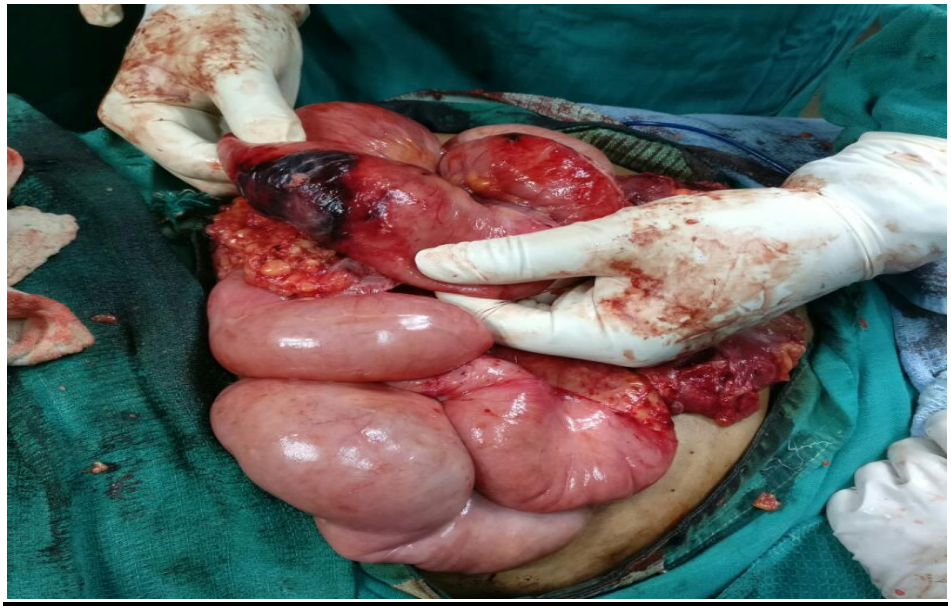
COMPARISON BETWEEN VIABLE AND NON-VIABLE BOWEL[1,7]

FEATURES	VIABLE BOWEL	NON – VIABLE BOWEL
(1) COLOUR	Pink in colour	Dark in colour (blackish)
(2) GENERAL APPEARANCE	Shiny	Dull and lusterless
(3) PULSATION	Visible pulsations in mesenteric arteries	No visible pulsations
(4) MUSCULATURE	Firm	Flabby, thin & friable
(5) PERISTALSIS	Present	Absent

If the viability of the bowel is in doubt, the bowel should be wrapped in warm saline pads for a period of 10 minutes, with increased oxygenation and then once again re-assessed.

All the non-viable bowel must be resected followed by anastomosing the two healthy bowel ends by using either conventional hand-sewn method or by mechanical staplers.

GANGRENOUS BOWEL



SPECIFIC CONSIDERATIONS

Intussusception [1]

This occurs when one portion of the bowel invaginates into an immediately adjacent segment. It is almost invariably the proximal into the distal bowel.

The condition is encountered commonly in chidren,with a peak incidence between 5 and 10 months ofage. About 90 of cases are idiopathic but an associated upper respiratory tract infection or gasteroenteritis usually precedes the condition.It is believed that hyperplasia of peyer's patches in the terminal ileum may be the initiating even .Weaning,loss of passively acquired maternal immunity and viral pathogens have all been implicated in the pathogenesis of intussuseption in infancy.

Adult cases are almost invariably associated with a lead point, which is usally a polyp(e.g. peutz-jeghers syndrome), a submucosal lipoma or a tumour. An intussusception has three parts :

(1) the entering tube (inner tube / intussusceptum)

(2) the returning tube (middle tube)

(3) the sheath (outer tube / intussuscipiens).

In children, ileo-colic intussusception is more common, whereas in adults, colo-colic variety is more common. The investigation of choice is either ultrasound or CT. Radiological reduction is sufficient in paediatric cases, whereas in adults, it may lead to a gangrenous segment, often requiring resection and anastomosis.

Volvulus [1]

It is the twisting or axial rotation of a portion the bowel about its mesentery. This rotation causes obstruction to the lumen (>180 degree torsion) and sometimes may be tight enough to cause vascular occlusion in the mesentery. (360 degree torsion). Bacterial fermentation firther adds to the distension thereby increasing the intra-luminal pressure, thus impairing capillary perfusion.

Volvulus may be either primary or secondary. Primary form often occurs secondary to congenital malrotation of the gut or abnormal mesenteric attachments or congenital bands. Secondary volvulus, which is the most common variety, is due to rotation of a segment of a bowel around an acquired adhesion or a stoma.

The commonest type of volvulus in adults is sigmoid volvulus. The other types are the caecal volvulus and small intestine volvulus.

Compound volvulus, also known as “ileo-sigmoid knotting” is that in which the ileum twists around the sigmoid colon, due to the presence of a long pelvic mesocolon. This may lead to bowel gangrene and requires resection and anastomosis either by hand sewn method or staplers.

Mesenteric ischemia[1,7]

Mesenteric vascular disease may be classified as :

1) ***Acute intestinal ischemia*** :

    - With obstruction,
    - Without obstruction.

2) ***Chronic intestinal ischemia***.

The most common cause of acute intestinal ischemia is embolism.

They tend to lodge at the origin of middle colic artery. Superior mesenteric vessels are the visceral vessels, most likely to be affected by embolization or thrombosis.

Possible sources for embolization includes :

1) Left atrium in atrial fibrillation
2) Left ventricle after mural myocardial infarction.
3) Vegetations on mitral and aortic valves in endocarditis.
4) Atheromatous plaque from aortic aneurysms.

* Low flow status ischaemia – more commonly known as "*NOMI"* (non – occlusive mesenteric ischaemia) is due to reduced SMA perfusion by the underlying causes such as, cardiogenic shock, mesenteric vasoconstrictionor part of the systemic disease. There is no documented thrombosis or embolus.

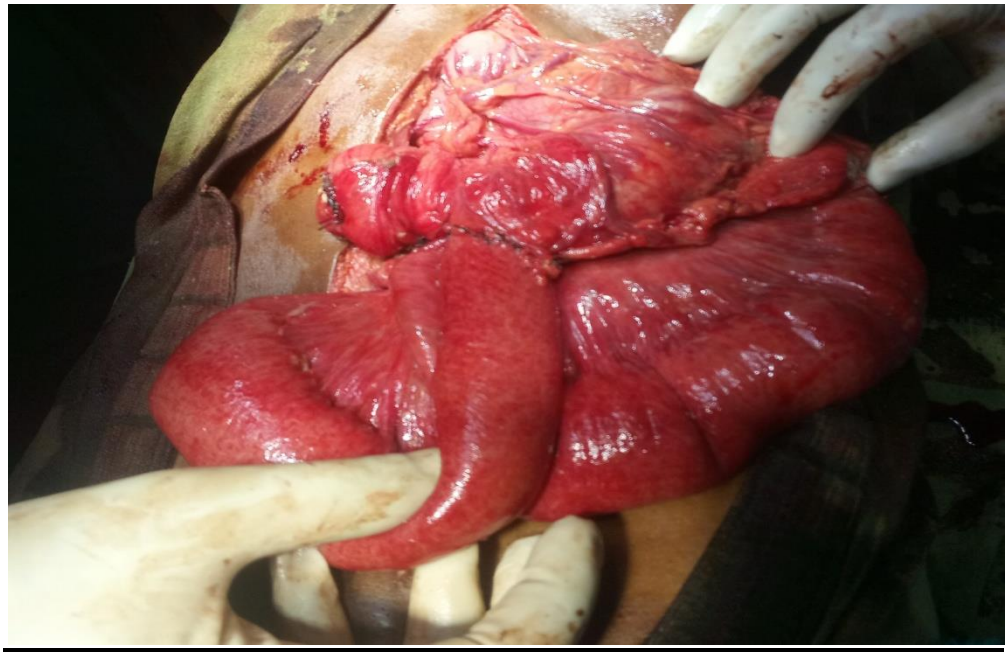
* *Gas bubble in the mesenteric vein* is the pathognomonic sign of irreversible mesenteric ischaemia.CT angiogram is the diagnostic. An occlusion at the ostium of the SMA signifies thrombosis. Embolic occlusion appears as smooth filling defects, usually distal to the origin of middle colic artery, thus sparing the proximal small bowel, right side colon and transverse colon. Emboli can be fragments, causing multiplepatchy necrosis of the bowel at different sites.

Clinical features:

1) Abdominal pain out of proportion to the clinical findings
2) Persistent vomiting
3) Passage of altered blood in stools
4) Shock, with features of both hypovolemia and sepsis.

A CASE OF ACUTE SMA OCCLUSION

TERMINAL ILEUM UPTO TRANSVERSE COLON IS RESECTED AND END-TO-SIDE ILEO-TRANSVERSE ANASTOMOSIS DONE



Management: [1,7]

Mesenteric ischaemia is an rapidly progressive fatal condition.

sloughing of intestinal mucosa occurs in 3 hours; while the infarction of entire thickness of bowel occurs in 6 hours.

If the patient presents within 6 hours, it is possible to prevent the gangrene and to salvage the bowel. Emergency SMA angiography should be done. Heparin (20,000 units loading dose and then maintenancedose of 5000-10000 units 6th hourly) or thrombolytics areinjected. Immediate laparotomy is then done. SMA is opened(arteriotomy) over the obstruction and the thrombus/embolusis removed using Fogarty catheter. Perfusion is restored. Close monitoring is essential for the possibility of formation ofbowel gangrene and if it is so, re-laparotomy should be donefor bowel resection.

If patient presents after 24-48 hours, gangrene mighthave already occurred, then resection and anastomosis is done. All the affected bowel should be resected and the healthy bowel ends should be anastomosed either by hand sewn or by stapler method.

COMPLICATIONS OF BOWEL RESECTION [5]

Some of the important complications of bowel resection are :

(1) Diarrhea

(2) Steatorrhoea,

(3) Fluid and electrolyte disturbances,

(4) Bacterial overgrowth,

(5) Nutritional deficiencies,

(6) Cholelithiasis,

(7) Hyperoxaluria and nephrolithiasis,

(8) Gastric hypersecretion.

Massive bowel resection[7]

Resection ofmore than 200 cm of the small bowel is known as massive resection.The metabolic sequelaein massive resection depend on

(i) extentand the anatomical site of resection;

(ii) functional capacity andadaptation of the small or large intestine;

It leads to

(i) gastrin hypersecretion and increased parietal cellmass in stomach eventually leading to peptic ulceration;

(ii) increasedlevels ofendocrinepancreatic secretion;

(iii) hypoalbuminaemia and oedema.

**Resection of more than 100 cm of the distal ileum* causes diarrhoea and steatorrhoea (steatorrhoea is faecal fat > 6 gram/day); increase in bile lithogenicity; deficiency of vitamins A, D, E, K.

*_Ileum_ maintains the entero-hepatic circulation of bile salts,absorption of vitamin B12 and vitamin D. Resection of the middle part of small bowel is better tolerated than the distal part.

*_Resection of ileocaecal valve_ reduces the intestinal transittime; reduces absorption of vitamin B12, calcium, magnesium and zinc; diarrhoea and contamination of shortenedsmall bowel by bacteria.

* In massive resection, _colonic bacteria_ degrade the fatty acidsinto lactate and short chain fatty acids. Normally, lactate reduces the colonic pH which inhibits bacteroides; due to this, acidresistant anaerobes will increase in colon which produces large amount of lactate which is absorbed causing _lacticacidosis._

Management includes :

(i) Total parenteral nutrition is given initially, later on followed by enteral nutrition, for intestinal adaption.

(ii) Fat and fibre free diet but protein rich liquid diet with all the essentialfatty acids.

(iii) for diarrhoea, loperamide/codeine phosphate can be given.

(iv)Oral cholestyramine can be given to bind bile salts.

(v) Parenteral vitamin B12 injection is given regularly.

(vi) H2 antagonists/PPIs/ somatostatin.

(vii) Octreotide, reduces the secretion and reduces GI motility.

(viii) Fluid and electrolyte management.

(ix) surgery.

Surgical techniques that are followed to delay the intestinal transit time are :

-*Reversal of 10 cm of the intestinal segment* to delay transit time.

- *Intestinal lengthening*,to delay transit time and to increasethe absorption surface.

- *Small bowel transplantation*is ideal, but graft rejectionand failure is the problem.

- Antiperistaltic colonic interposition into small bowel segment.

- Longitudinal splitting of the intestine and closing ofthese as separate tubes which are then anastomosed to eachother to achieve lengthening – "*Binachi's surgery"*.

- Mucosal *stem cell transplantation using enterocytes*without lymphoid tissue is under trial.

- Seeded mucosal autografts in prosthetic tubes.

Short gut syndrome[7]

It is also known as "short bowel syndrome" . It is the symptom complex occurring after massive small bowel resection i.e.,*resection more than 70% of the bowel*. Usually the minimum bowel required is 1.2 meters. Proximal jejunal resection is better tolerated than the distal ileal resection. Ileum is more adaptive

and has got capacity to increase the absorption capacity more efficiently than any other part of the bowel. So in massive resections, patients with retained ileum will tolerate better. Adaptation is better, if ileum and caecum are preserved.The adaptive changes in the retained small bowel are :

- Villous hypertrophy and hyperplasia,
- Increased capacity of the small bowel,
- Increased absorptive surface,
- Lower transit time of bowel content.

BOWEL ANASTOMOSIS

Basic principles of anastomosis[1]:

i) To ensure good blood supply to both bowel ends before and after formation of an anastomosis.

ii) The anastomosis is under no tension.

iii) To avoid applying clamps or sutures to mesenteric vessels as it may damage them.

iv) Atraumatic bowel clamps should be used to minimize contamination.

v) If bowel ends are not of equal size, a cheatle split (making a cut in the antimesenteric border) may help to enlarge the lumen of the distal collapsed bowel, to allow end to end anastomosis.

vi) In all anastomosis, the mesentery should always be closed, to avoid the later risk of internal hernias.

Methods of anastomosis :

Bowel anastomosis can be done either by

1) Conventional hand sewn technique
2) Mechanical staplers.

Bowel anastomosis can be either

1) End to end
2) End to side
3) Side to side

Peri-operative Management:

1) Fluid and electrolyte management using crystalloids and colloids.
2) Broad spectrum antibiotics for sepsis control.
3) To ensure good nutritional support by giving Inj. Astymin, Total parenteral nutrition, etc.,
4) Prevention of skin infection.
5) Deep venous thrombosis prophylaxis by compression stockings, inj. Heparin, calf compression etc.,

Complications of bowel anastomosis:

- Anastomotic bleed
- Anastomotic leak
- Anastomotic stricture
- Paralytic ileus
- Wound dehiscence.

ANASTOMOTIC LEAK[8]

It is the most dreaded complication after performing an anastomosis.

Zuri A murrel et al described the potential causative factors for anastomotic leak.These includes :

1) Emergency surgery in an unprepared gut,

2) Poor nutritional status,

3) Obesity,

4) Faulty technique of anastomosis,

5) Infection,

6) Increased number of blood transfusions,

7) Radiation,

8)Immunocompromised status.

Clinical features:

1) Fever,

2) Tachpnoea,

3) Tachycardia,

4) Oliguria,

5) Ileus,

6) Leucocytosis,

7) Leakage of enteric contents via the wound on the drain.

Management[7]:

It depends on whether the leak is either low output (200 to 500ml) or high output (> 500ml). The measures include :

(i)*Resuscitation and restoration* of volume with crystalloids and colloids.

(ii) Total parenteral infusion and albumin infusion.

(iii)*Sepsis control* with antibiotics.

(iv)*Skin care,*to prevent excoriation using Karya powder, zinc oxide cream/powder, ion exchange resins etc., Stoma adhesiveand controlled fistula drainage using sump constructedsuction catheter drain system or vacuum assisted closure(VAC) system or silicone barrier or created inverted conesystem can be done.

(v)*Reduction in output of fistula*- by proton pump inhibitors,histamine antagonists, sucralfate and octreotide can be given.

(vi)*Nutrition*: Nutritional status should be assessed either clinically (weight, anthropometry) or by biochemical methods. Carbohydrates = 30 Kcalories/kg/day; Proteins 1.5 grams/kg/day is the basic need.Initially TPN can be used. Once patient tolerates oral, enteralfeeding should be started. Enteral feeding (oral/gastrostomy/jejunostomy) is contraindicated in the presenceof a distal obstruction. Enteral feeding reduces sepsis,improves the bowel activity, caliber, thickness and the abilityto hold sutures. It also avoids TPN related problems.

(vii)*Fistulogram* using a water soluble contrast, *CT or MR fistulogram*

tosee the pathological anatomy of fistula—site, number, length,status of the bowel, distal obstruction and the presence of abscess cavity.*Biochemical analysis* (electrolytes, haematocrit andalbumin) and renal, hepatic, respiratory, cardiac statusshould also be assessed.

(viii) Most of the low outputfistulas are likely toclose spontaneously, whereas certain high output fistulas need a definitive procedure.*Definitive procedure* is done for fistula only after 6 weeks.Mortality and recurrence is higher, if operated prior to 6 weeks, due to obliterative peritonitis. The following steps are usuall done in EC fistula repair :

- *Reopening* should be done through a *new*,often by a transverse incision.
- *Bowel refunctionalisation*,by freeing entire bowel from the ligament of Treitz to rectum should be done to clear all the adhesions and obstructions and areas of sepsis andabscesses.

-*Resection of the bowel adjacent to fistula along* with trackis the ideal procedure with end to end meticulous two - layered closure using interrupted 3- 0 silk sutures.

- When it is not possible, fistula area bypass / Roux-en-Y drainage or serosal patch technique is used.

- Duodenalfistula is managed by bypass using gastrojejunostomy and vagotomy without intervening thefistula.

-*Proper irrigation of the abdominal cavity* with saline and antibiotics during the procedure should be followed.Various solutions to prevent adhesions are also commonly done.

- Supportive jejunostomy maybe added, for enteral feeding.

- *Abdominal wall closure* is important and it can be done either by primary closureor by using myocutaneous flap. Meshes should not be usedfor closure, as *recurrent fistulas are* common.

CONVENTIONAL TECHNIQUES OF ANASTOMOSIS

GASTROJEJUNOSTOMY[6]

Billroth II loop gastrojejunostomy is the commonly preferred technique of reconstruction following subtotal gastrectomy.Alternatively Roux-en –y gastrojejunostomy can be done to prevent alkaline reflux gastritis. After identifying the ligament of Treitz ,a loop of jejunum is brought upto the gastric pouch in an end to side isoperistaltic fashion with the proximal enf of the jejunum apposed to the lesser curvature side of the opening in the stomach. An outer posterior row of interrupted lembert's seromuscular sutures is put using 3-0 silk ,between the posterior gastric wall and the jejunum. Jejunostomy is done with the help of electro-cautery. The inner posterior layer of anastamosis is done using 3-0 PDS or vicryl in a continuous full thickness fashion. The inner layer of anastomosis is continued anteriorly as a running connel suture ,which inverts the anastomosis . Nasogastric tube is advanced through the gastric remnant just to the efferent limb

of the jejunum before the completing the anastomosis. In Roux-en-Y gastro-jejunostomy, the ligament of Treitz is identified, and the jejunum is divided 40 to 50 cm distal to it. The distal end is then mobilized and and anastomosed to the dependent part of the gastric greater curvature. The proximal jejunum is then anastomosed to the Roux limb, 60 cm distal to the gastro-jejunostomy site. After completion of the anastomosis, lumen patency should be checked and then the abdomen is closed in layers.

JEJUNO-JEJUNAL / ILEO –ILEAL ANASTOMOSIS

This can be done either by end –to –end or by side –to –side fashion. After completing the resection ,the two ends of the bowel are brought together and the inner two layers are closed in a continuous full thickness fashion using 3-0 vicryl or PDS (connel stitch). Care should be taken to avoid injuring the mesenteric vessels. The outer two layers are closed in an interrupted manner using 3-0 silk, including the seromuscular layer only (lembert's stitch). Mesenteric window is then closed using 3-0 silk ,to avoid internal hernia. Abdominal drains are kept and the abdomen is closed in layers.

ILEOTRANSVERSE ANASTOMOSIS

This can be done either end-to-side (preferred)or side –to-side. After completion of resection ,the cut end of transverse colon is closed in two layers,the inner full thickness layer with 3-0 vicryl and the outer seromuscular layer using 3-0 silk. The cut end the of ileum is mobilized and brought upto the transverse colon.

Initially, the fourth interrupted seromuscular layer is done using 3-0 silk. An opening is made in the transverse colon and the second and third layers are closed by full thickness continuous suture using 3-0 vicryl or PDS.The first interrupted seromuscular layer done using 3-0 silk. Lumen patency is then checked. Drains are kept at the anastomotic site and the abdomen closed in layers.

Advantages of hand sewn anastomosis :

(i) readily available,

(ii) cost – effective,

(iii) learning curve is simple.

Disadvantages :

(i) Prolonged surgery time,

(ii) More periods of hospital stay,

(iii) Operator dependent.

(iv) Difficult in certain anatomical sites such as, colorectal anastomosis and esophago-gastric anastomosis.

MECHANICAL STAPLERS [3]

The major advantages of staplers over conventional hand sewn anastomosis:

1) It saves time ,especially if multiple anastomosis are required for a single case. Eg whipples procedure ,radical cystectomy etc

2) Helpful in difficult sites like rectum and esophagus where anastomosis is difficult.

Types of staplers :

1) Transverse anastomosis stapler (TIA),

2) Gastrointestinal anastomosis linear cutter (GIA) stapler,

3) Circular end to end anastomosis stapler (EEA),

4)Endoscopic stapling device (endo GIA gun).

The configuration of the closed staples is in ***the shape of the letter "B".***

Nowadays the stapler are made of ***titanium***,which have the following benefits :

1) Produces minimal artifacts in CT.

2) Non –magnetic. Therefore they doesn't cause distortions in MRI.

3) High resistance ,but lighter than stainless steel.

4) Corrosion resistant.

1) LINEAR STAPLER[1] :

Linear staplers are used to close the ends of a hollow organ or a vessel .These staplers usually applies two lines of staplers ,that are staggeredto maximize local blood supply.

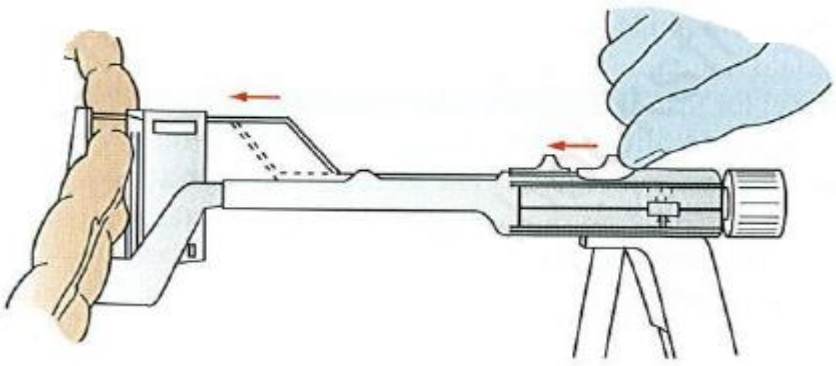
2) ***LINEAR CUTTER STAPLER[1]***:

These staplers have an integrated cutting device .These provide two or three rows of staggered staples and the tissue between the two staple is transected.

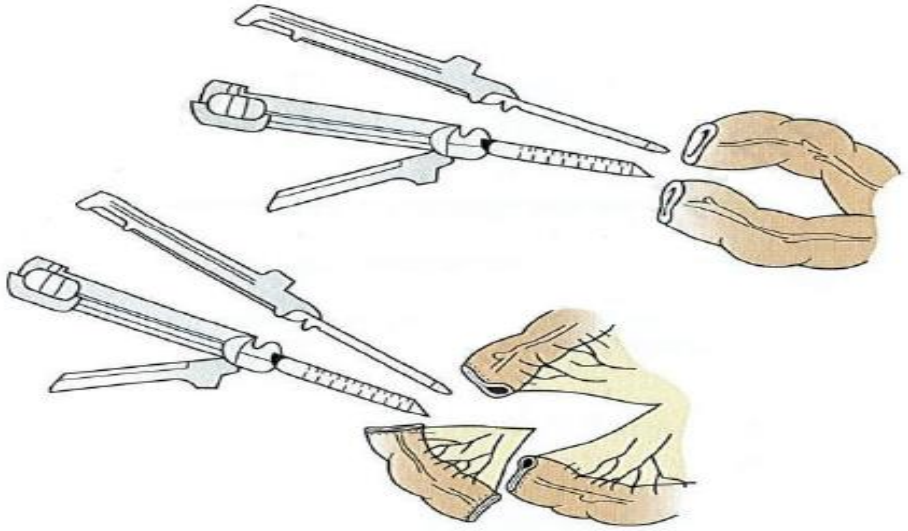
- Length of staple lines = 30mm to 90 mm.
- Height of individual staples =2.5mm to 4.8mm.
- Vascular staples =2.5mm.
- For intestinal tissues =3.5mm.
- For stomach or thicker tissues =4.8mm.

One can use different sizes of cartridges and staples .

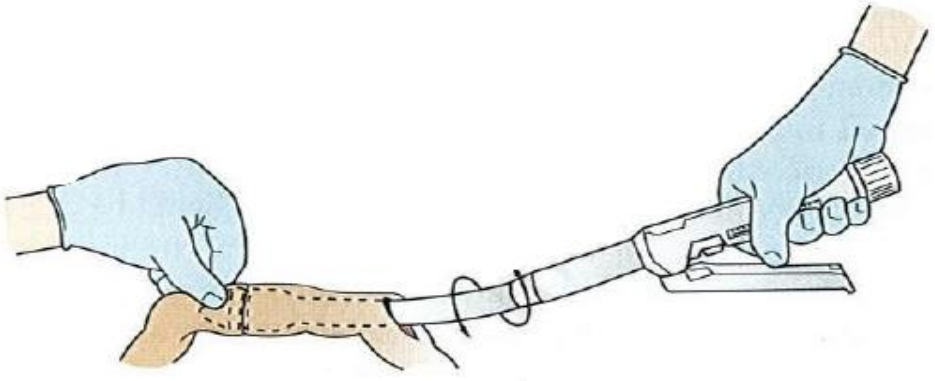
TRANSVERSE ANASTOMOSIS STAPLER



LINEAR CUTTER STAPLER



END TO END ANASTOMOSIS STAPLER (EEA)



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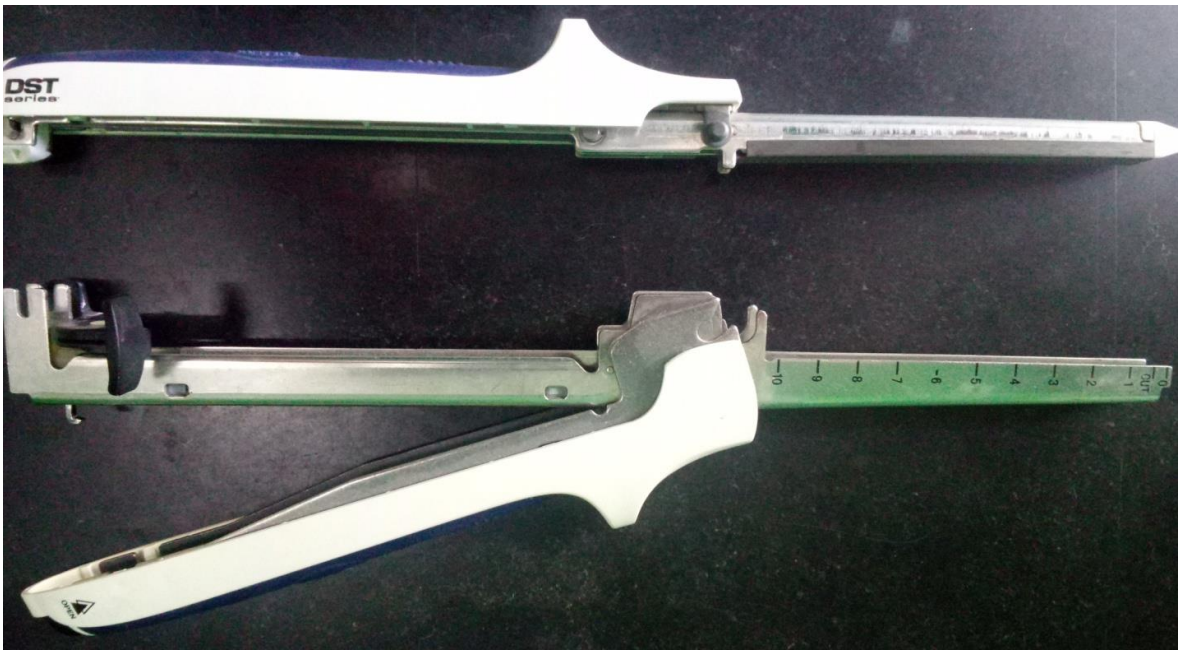
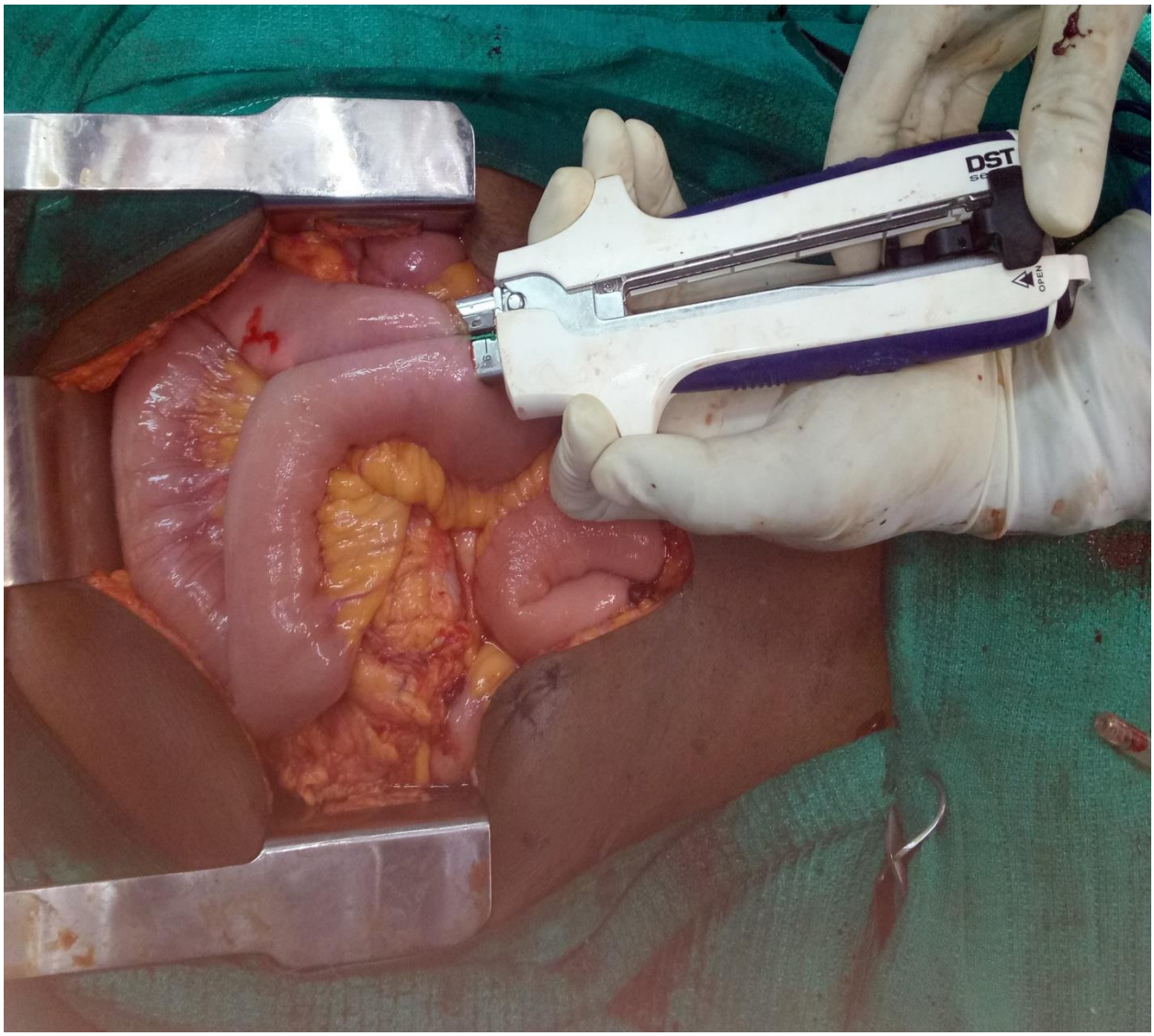


SIDE-TO-SIDE ANASTOMOSIS USING LINEAR CUTTER STAPLER



COLOUR CODED CARTRIDGES

**White* cartridges are for vascular anastomosis .

**Blue* cartridges are for small bowel and colonic anastomosis .

**Green* cartridges are for thicker tissues like stomach and rectum.

The staple height is fixed and one must choose the instrument in accordance to the type of the tissue.

3) CIRCULAR STAPLERS[1] :

These are used for end to end anastomosis especially in esophageal and colorectal anastomosis. They fix two staggered circular lines of staples.After firing ,an integrated circular scalpel resects overlying tissue as 'hinge'or 'donuts' of tissue to create a circular anastomosis.

METHOD OF STAPLER ANASTOMOSIS

Staples can be used to create :

1) End –to –end anastomosis

2) Side –to-side anastomosis

3) Closure of a cavity.For example ,Gastric conduit closure after subtotal gastrectomy.

1)End –to-end anastomosis[1]:

After resection ,the detached stapling head or anvil is introduced into one –end of the bowel ,usually secured within it ,by means of a purse string suture.The body of the device is then introduced into the other end of the

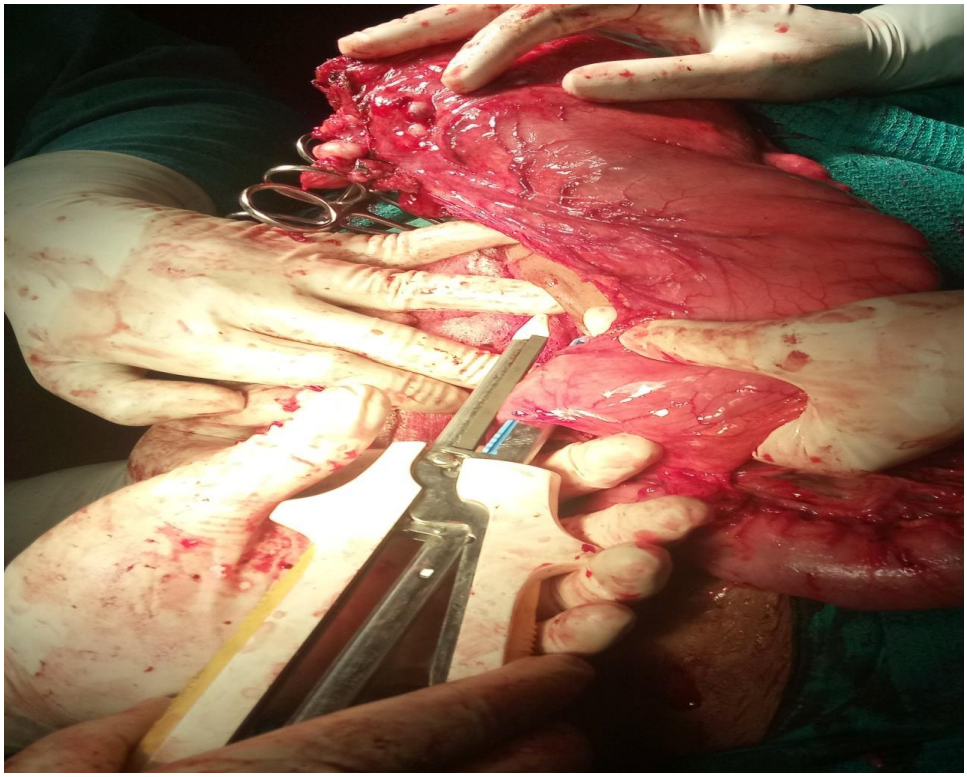
bowel. The shaft is either extended through a small opening in the bowel wall ,or secured by a purse string suture .The head (anvil) is then reattached to the shaft , and the two ends are then approximated.Once the device is fully closed,it is fixed and the stapler is gently withdrawn.It is important to assess the integrity of the anastomosis ,by examining the ‘doughnuts’of tissue excised.These are used for esophageal and low rectal anastomosis.

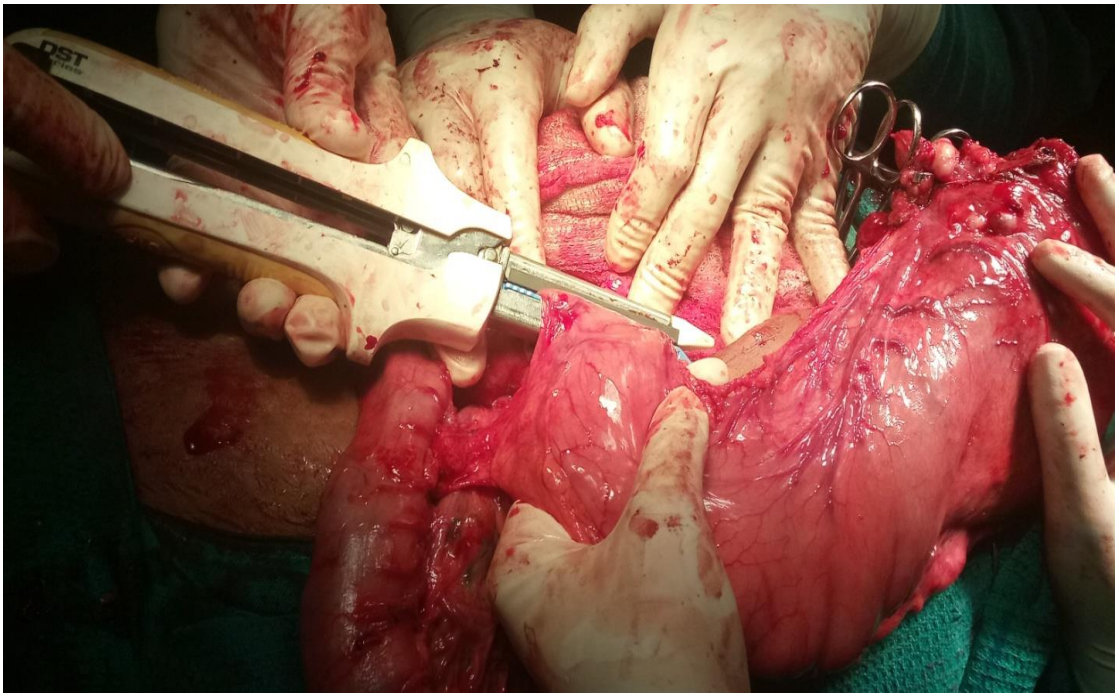
2) Side –to-side anastomosis[1]:

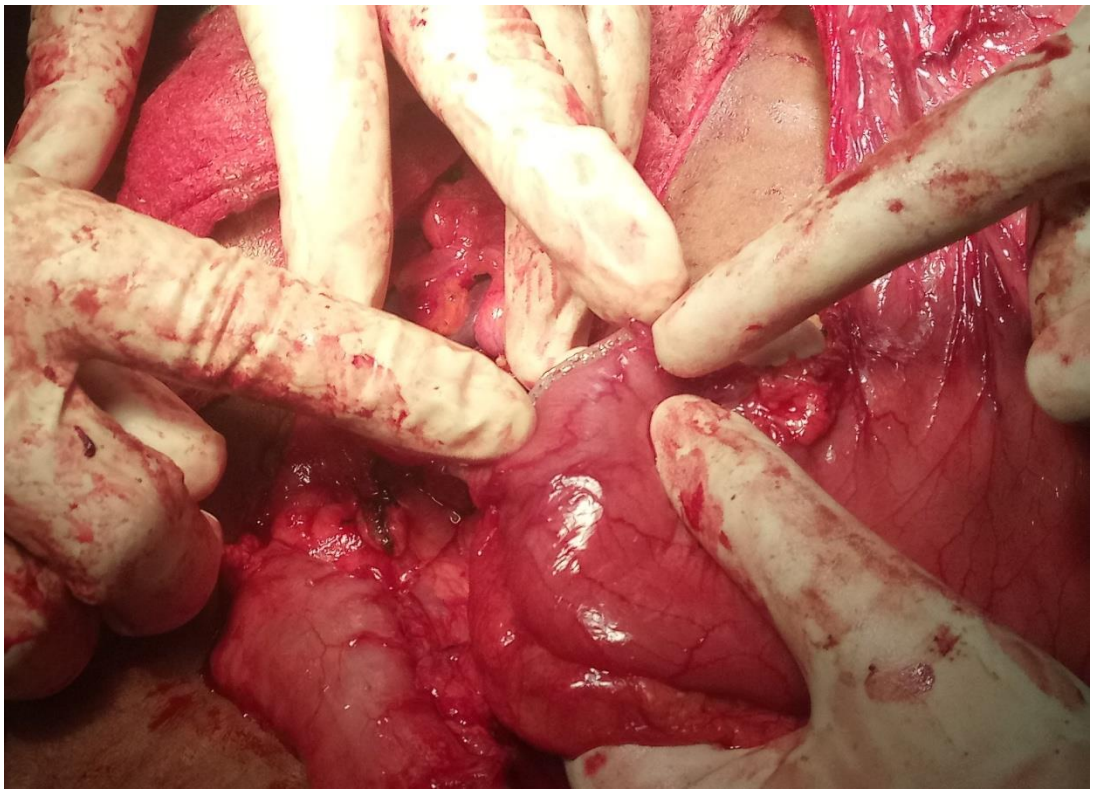
This is done with the help of linear staplers which have two limbs, that can be detached .Each limb is introduced into a loop of the bowel ,the limbs are reassembled and the device is then closed .On firing,the two rows of staggered lines of staples are inserted on either side of the divided bowel ,the division occurs by means of a built-in-blade ,that is activated at the same time as the staples are inserted.

These are used for fashioning a gastro-jejunostomy or jejuno jejunostomy and ileal pouch formation.

STAPLED GASTRO-JEJUNOSTOMY







This study can be under taken to know the advantages of stapler anastomosis over conventional hand -sewn anastomosis ,in respect to :

1)Time taken for the procedure,

2) Appearance of bowel sounds,

3)Resumption of oral feeds,

4) Post –operative hospital stay,

5) Incidence of complications – Anastomotic bleed,

Anastomotic leak &

Anastomotic stricture.

MATERIALS AND METHODS

This is a hospital based comparative type of study. A minimum of 50 cases(25in each group)which meets the inclusion & exclusion criteria are included in this hospital based comparative study.

ELIGIBILITY CRITERIA

A.Inclusion criteria

1) All patients admitted to the general surgey wards requiring elective as well asemergency gastro-intestinal surgeries who undergo bowel anastomosis for various benign and malignant conditions.

2) Male or female subjects between the ages of 12 and 80 yrs undergoing various gastrointestinal surgeries.

3) Subjects who gave written informed consent after reviewing the informed consent document.

B.Exclusion criteria

1)Age less than 12 yrs and more than 80 yrs

2)All pregnant patients

3) Patients undergoing radiotherapy

4)Patients of coagulopathy & patients on anti-coagulation

5)Patientswho not consented for inclusion in the study

METHODOLOGY

The patients who are admitted for elective as well as emergency resection& anastomosis for various illness are selected after thorough clinical examination and investigations to confirm the diagnosis co- morbid conditions.Details are recorded in the proforma prepared.

Pre-operative anemia ,diabetes,hypertension should be controlled. They have standard bowel preparation and prophylactic antibiotic should be given. When planned for resection and anastomosis, patients are randomly chosen for hand sewn and stapler anastomosis.The various observations like time taken for the procedure,time taken for the bowel sounds to return,resumption of oral feeds, post-operative complications like anastomotic leak and mortality are recorded in the charts.

The patients are assessed till discharge from the hospital.The reports are compared between the stapler and hand sewn anastomosis and also compared with other studies.

The following stastical tests used to compare the results of stapler group and hand sewn group :

(1) Independent samples T-test, to compare mean values between the two methods.

(2) Chi-square to test to compare the proportion of two values.

The observations are analyzed statistically. (P-value <0.05 = significant).

Study place :

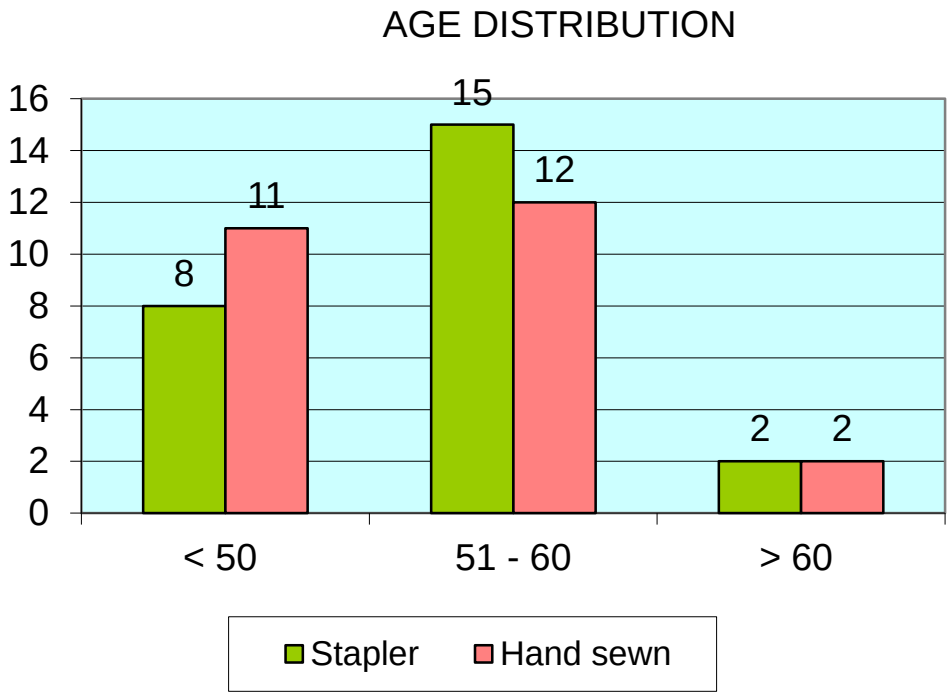
Department of general surgery,

Madurai medical college, Madurai.

Study duration :

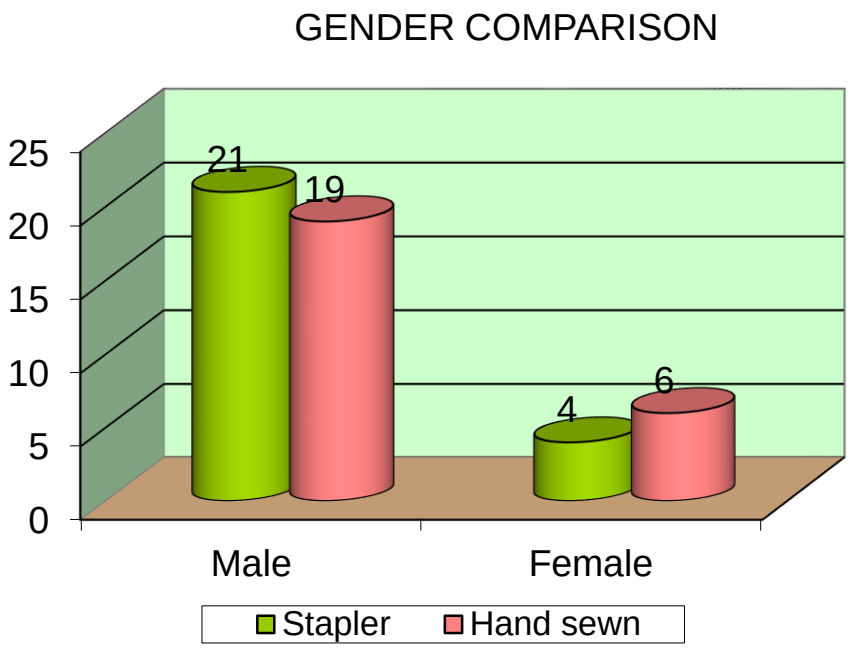
November 2017 to September 2018.

RESULTS



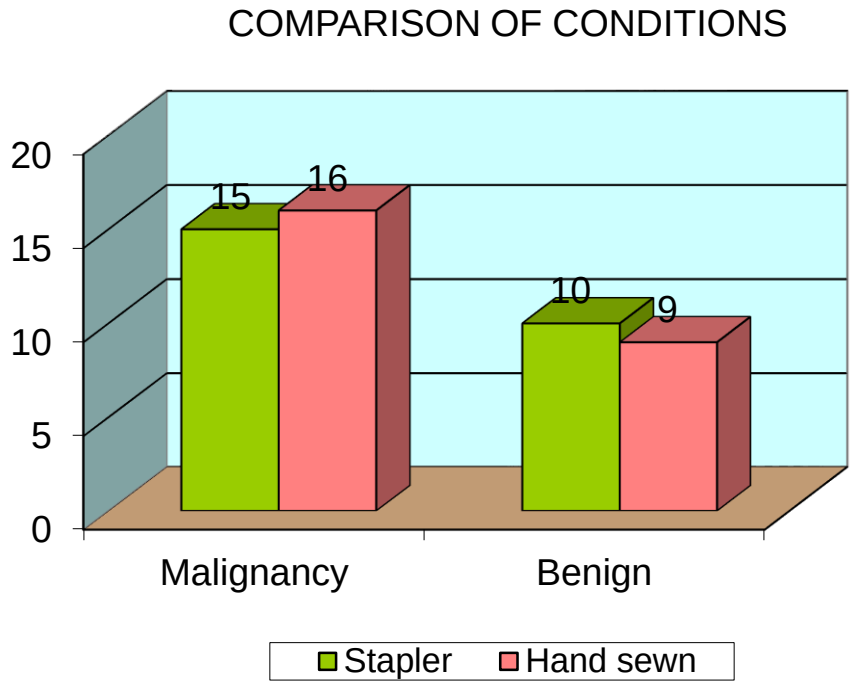
Age in years	Stapler	Hand sewn
< 50	8	11
51 - 60	15	12
> 60	2	2
Total	25	25
Mean	53.2	52.44
SD	6.131	6.076
p value	0.662 Not significant	

In comparison with age, the mean age in stapler group is 53, while in the hand sewn group, it is 52, which is statistically not significant (p value= 0.662).



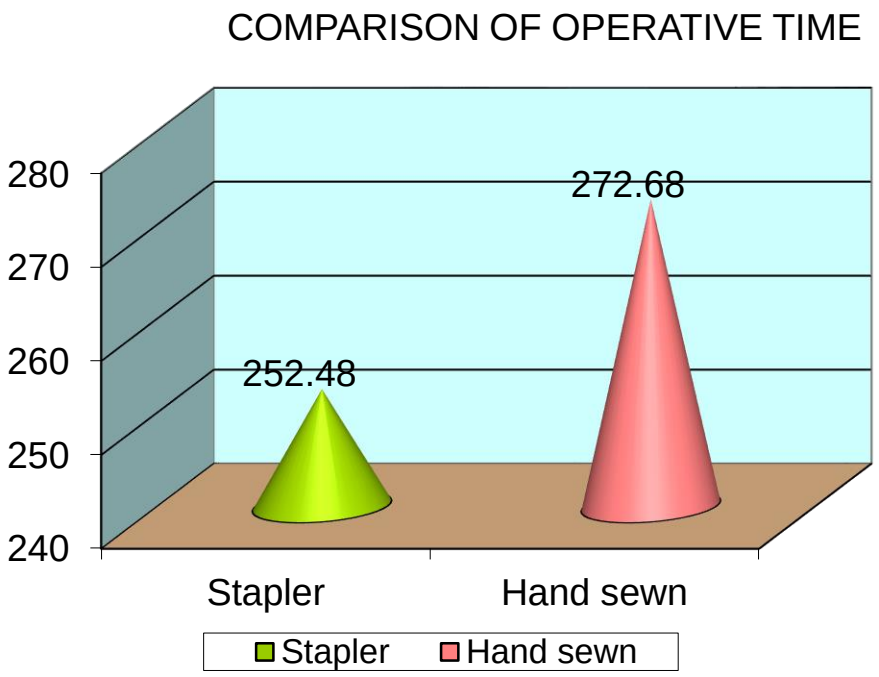
Sex	Stapler	Hand sewn
Male	21	19
Female	4	6
Total	25	25
p value	0.724 Not significant	

In this study, majority of them were males (80%), while the females accounted to 20% only.



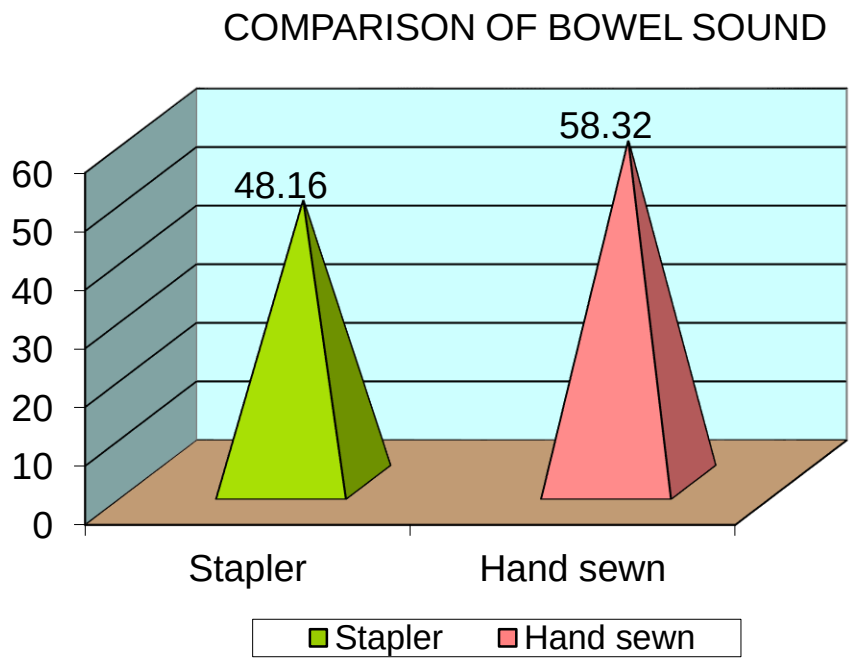
Conditions	Stapler	Hand sewn
Malignancy	15	16
Benign	10	9
Total	25	25
p value	1.0 Not significant	

In this study, malignancies of GI tract accounted for majority of the reasons for resection and anastomosis (31 cases out of 50), while the benign conditions such as polyps, intussusceptions, mesenteric ischemia etc accounted for only 19 cases.



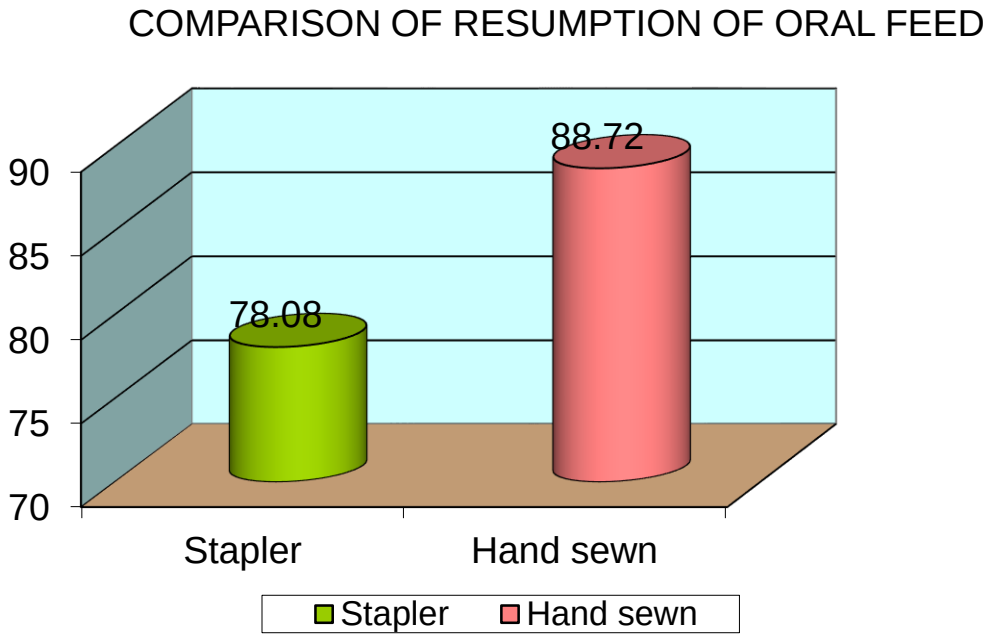
Operative time	Stapler	Hand sewn
< 250	10	0
> 250	15	25
Total	25	25
Mean	252.48	272.68
SD	8.332	15.924
p value	<0.001 Significant	

The mean operating time in stapler group is 252 minutes while that in hand sewn group is 272 minutes. The p value is <0.001 which is stastically significant.



Bowel sound	Stapler	Hand sewn
< 50	19	0
> 50	6	25
Total	25	25
Mean	48.16	58.32
SD	1.519	4.423
p value	<0.001 Significant	

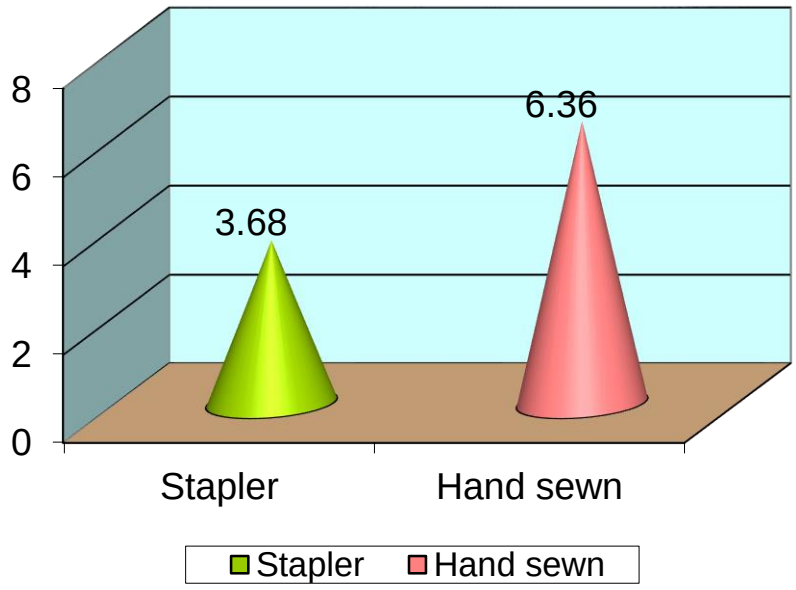
The mean time of appearance of bowel sounds in stapler group is 48 hrs, while in hand sewn group, it is 58 hrs i.e., 10 hrs later than that of the stapler group. This is stastically significant (p value < 0.001).



Resumption of oral feed	Stapler	Hand sewn
< 80	12	0
> 80	13	25
Total	25	25
Mean	78.08	88.72
SD	3.718	4.198
p value	<0.001 Significant	

In stapler group, oral feeds are started 78 hrs after surgery, while in hand sewn group oral feeds started 88 hrs after the procedure, which is significant.

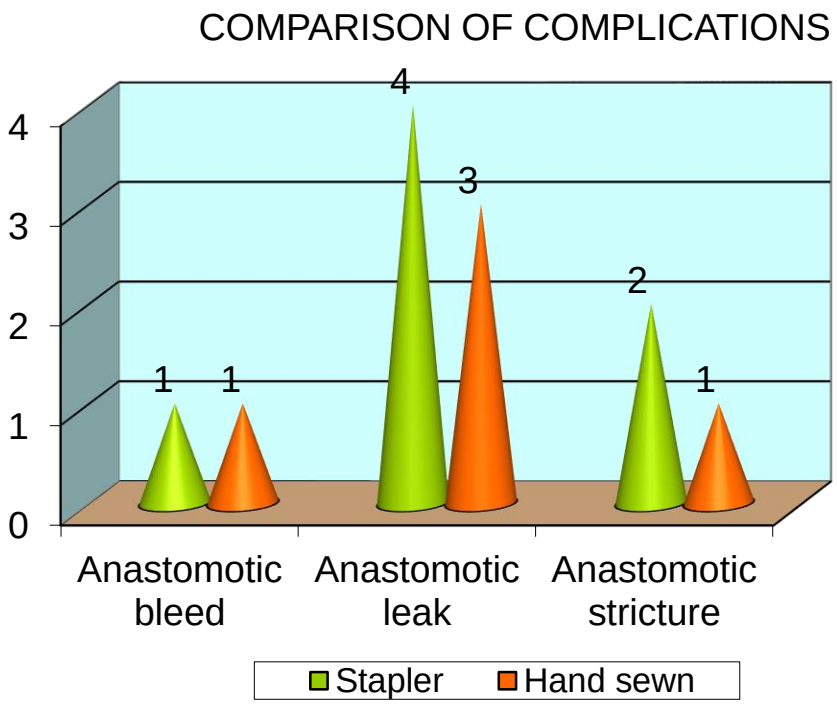
COMPARISON OF POST OP HOSPITAL STAY



Post op Hosp. stay	Stapler	Hand sewn
< 5	18	3
> 5	7	22
Total	25	25
Mean	3.68	6.36
SD	1.249	1.729
p value	<0.001 Significant	

The mean duration of hospital stay in stapler group is 4

days while that in hand sewn group is 6 days. This is due to early return of bowel activity and the resumption of oral feeds earlier in stapler group.



Complications	Stapler	Hand sewn
Anastomotic bleed	1	1
Anastomotic leak	4	3
Anastomotic stricture	2	1
Total	7	5
p value	0.892	Not significant

The incidence of complications such as anastomotic leak, anastomotic bleed and anastomotic stricture are 7 in stapler group and 8 in hand sewn group. The p value is 0.892, which is statistically significant.

DISCUSSION

In this study, a total of 50 cases who are admitted in GRH, Madurai for either benign or malignant condition requiring resection and anastomosis from the period of September 2017 to September 2018 are included. The cases are chosen randomly for the stapler group (25 cases) and the hand sewn group (25 cases).

Among them most of the cases are males (80%). The median age group in the stapler group is 53, while in hand sewn group is 52. The p value is 0.662 and is statistically insignificant. Malignant conditions of the GI tract accounted for majority of the condition where resection and anastomosis is performed (31 out of 50 cases). P value in the groups are 1.0 and so it is statistically insignificant.

The mean operating time in stapler group is 252 minutes, while in the hand sewn group it is 272 minutes. P value is <0.001 and is statistically significant. The time of appearance of bowel sounds and the resumption of oral feeds are also earlier in stapler group with a significant p value.

The cases are followed up till discharge. No cases are lost in the follow up period. The complications encountered are anastomotic leak (4 in stapler, 3 in hand sewn), anastomotic bleed (1 in stapler, 1 in hand sewn), and anastomotic stricture (2 in stapler group, 1 in hand sewn group). P value is 0.892 and is stastically insignificant. So the incidence of complications are similar in both the stapler group and the hand sewn group.

CONCLUSION

From the above data analyzed, I conclude that stapler anastomosis is superior to the conventional hand sewn anastomosis in terms of :

- lesser operative time,
- earlier return of bowel sounds and the resumption of oral feeds,
- lesser duration of hospital stay.

In terms of the incidence of complications such as anastomotic leak , there is no significant difference observed in both the groups. So the complications will be lesser in both stapler as well as hand sewn group, if we follow the golden principles of anastomosis.

ANNEXURE

BIBLIOGRAPHY

1. Bailey and love's short practice of surgery, 27th ed., CRC Press, Taylor & Francis group, ISBN number -13: 978-1-138-03164-7, volume -1 pages 96 to 99, volume -2 pages 1280 to 1298, pages 1240 to 1257.

2. Comparative Study of Bowel Anastomosis - Hand Sewn VersusStapler**.,** Shubhakar Bhandary, Nakul Mahesh Babu, Ganesh Gojanur, Chaitanya Kumar Reddy P, IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)e-ISSN: 2279-0853, p-ISSN: 2279-0861.Volume 15, Issue 12 Ver. VIII (December. 2016), PP 37-42
www.iosrjournals.org

3. Damesha N, Lubana PS, Jain DK, Mathur R (2008) A comparative study of sutured and stapled anastomosis in gastrointestinal operations. Internet J Surg 15(2)

4. B D Chaurassia's Human anatomy 6th edition volume -2, CBS Publishers & distributors pvt Ltd, ISBN Number : 978-81-239-2331-4 , pages 229 to 244, pages 257 to 283.

5.Skandalakis' Surgical Anatomy : The embryologic and anatomic basis of modern surgery.,
John E. Skandalakis, Gene L. Colborn, Thomas A. Weidman, Roger S. Foster, Jr., Andrew N. Kingsnorth, Lee J. Skandalakis, Panajiotis N. Skandalakis, Petros S. Mirilas, Volumes 1 and 2., ISBN Number : 960-399-199-8.

6. Fischer Mastery of surgery 5th edition, Lippincott William & Wilkins ISBN : 978-0-7817-7165-8, Pages 817 to 938, pages 1380 to 1408, pages 1424 to 1532.

7. SRB's Manual of surgery 4th edition, Jaypee brothers medical publishers(P) Ltd, ISBN : 978-93-5025-944-3, Pages 922 to 1004.

8. Kirk RM, Winslet M. Essential General Surgical Operations. Edinburgh: Churchill Livingstone; 2001.

9. Afsar Ali Bhatti et al: Comparison of Outcome between Stapled verses Hand Sewn Intestinal Anastomosis. PJMHS 7:921, 2013.

10. Hassanen A, Darwish A, Bieh HA. Stapled versus hand-sewn anastomosis of the large bowel due to abdominal trauma: a
prospective comparative study. Egyptian Journal of Surgery. 2008 Oct;27(4):208-212.

11. Kracht M, Hay JM, Fagniez PL, Fingerhut A. Ileocolonic anastomosis after right hemicolectomy for carcinoma: stapled or handsewn?
A prospective, multicenter, randomized trial. Int J Colorectal Dis 1993; 8: 29-33.

12. Himabindu et al: Comparative Study between Staplers and Conventional(Hand-Sewn) Anastomosis in Gastrointestinal Surgery.
Indian J Surg. 2012 Dec; 74(6): 462–467.

13. Damesha N, Lubana PS, Jain DK, Mathur R (2008) A comparative study of sutured and stapled anastomosis in gastrointestinal
operations. Internet J Surg 15(2).

14. George WD, West of Scotland and Highland anastomosis study group Suturing or stapling in gastrointestinal surgery: a prospective
randomized study. Br J Surg. 1991;78:337–341. doi: 10.1002/bjs.1800780322.
15. Hollender LF, Blanchot P, Meyer C, da Silva e Costa JM. Mechanical suturing apparatus in gastrointestinal surgery. ZentralblChir.
1981;106(2):74–83.
16. MacRae HM, McLeod RS. Handsewn vs. stapled anastomosis in colon and rectal surgery: a meta-analysis. Dis Colon Rectum
1998;41(2):180-9.
17. Quan et al: Hand-sewn vs linearly stapled esophagogastric anastomosis for esophageal cancer: A meta-analysis, World J
Gastroenterol. 2015 Apr 21; 21(15): 4757–4764.
18. Scher KS, Scott-Conner C, Jones CW, Leach M. A comparison of stapled and sutured anastamoses in colonic operations.
SurgGynecol Obstet. 1982;155:489–493.
19. Scher KS, Scott-Conner C, Ong WT. A comparison of stapled and sutured anastamoses in gastric operations. SurgGynecol Obstet.
1982;154:548–552.
20. Reiling RB, Reiling WA, Jr, Bernie WA, Huffer AB, Perkins NC, Elliott DW. Prospective controlled study of gastrointestinal

stapled anastamoses. Am J Surg. 1980;139:147–152.

21. Docherty JG, McGregor JR, Akyol AM, Murray GD, Galloway DJ. Comparison of manually constructed and stapled anastomosis in colorectal surgery. West of Scotland and Highland Anastomosis Study Group. Ann Surg. 1995;221:176–184.

22. Lustosa SA, Matos D, Atallah AN, Castro AA. Stapled versus handsewn methods for colorectal anastomosis surgery: a systematicreview of randomized controlled trials. Sao Paulo Med J/Rev Paul Med. 2002;120(5):132–136.

23. Nasir Khan MU, Abir F, Longo W, Kozol R. Anastomotic disruption after large bowel resection. World J Gastroenterol. 2006;12(16):2497–2504.

24. Frances Goulder: Bowel anastomosis: The theory, the practice and the evidence base. World J Gastrointest Surg. 2012 Sep 27; 4(9): 208–213.

25. SuzanaAngélica et al: Stapled versus handsewn methods for colorectal anastomosis surgery: a systematic review of randomized controlled trial. Sao Paulo Med. J. vol.120 no.5 São Paulo July 2002

PROFORMA

Name :-	I.P. No :-
Age :-	Unit :-
Sex :-	D.O.A :-
Occupation :-	D.O.Surgery :-
Address :-	D.O. D :-
Phone no :	

CHIEF COMPLAINTS:

1) abdominal pain,
2) abdominal distension,
3) abdominal lump,
4) loss of weight and appetite,
5) nausea / vomiting,
6) hemetemesis / melena
7) other complaints.

HISTORY OF PRESENTING ILLNESS:

PAST HISTORY :

1) History of similar complaints
2) Treatment taken

3) History of previous surgeries

4) History suggestive of Hypertension/ Diabetes/ TB.

PERSONAL HISTORY :

Diet: Vegetarian/ Mixed

Habits: Smoking/ Alcohol/ Tobacco

Bowel & bladder habits

FAMILY HISTORY :

MENSTRUAL & MARITAL HISTORY

GENERAL EXAMINATION :

1. General survey
2. Body build and nourishment
3. Appearance
4. Attitude: Restless/ Quiet
5. Dehydration: Mild/ Moderate/ Severe/ Nil
6. Anaemia/ Jaundice/ Clubbing/ Cyanosis/ Lymphadenopathy/ Pedal oedema
7. Pulse
8. Temperature
9. Respiratory rate
10. Blood pressure

EXAMINATION OF ABDOMEN :

1. INSPECTION
2. PALPATION
3. PERCUSSION
4. AUSCULTATION

VAGINAL EXAMINATION :

RECTAL EXAMINATION :

SYSTEMIC EXAMINATION :

- Cardiovascular system
- Respiratory system
- Central nervous system
- Genito-urinary system

INVESTIGATIONS :

1. Blood: Hb % - 2.TLC - 3. DC-

4. ESR- 5. BT - 6. CT -

7. Platelet count -

8. Blood grouping & Rh typing -

9. Viral markers -

10. Others -

11. Urine: Albumin/ Sugar/ Microscopy

12. Chest x-ray / x-ray Abdomen erect view

13. USG abdomen and pelvis and CT abdomen

14. OGD Scopy & Colonoscopy (if needed) –

15. Others -

DIAGNOSIS :

PLAN :

Pre operative instructions -

Type of Anaesthesia -

Procedure done –

Type of incision -

Post-operative instructions -

Post-operative period –

Post-operative complication & management -

ஆராய்ச்சி தகவல் அறிக்கை

மதுரை அரசு இராசாசி மருத்துவமனையில் வரும் நோயாளிக்குள் வயிற்றில் ஒரு ஆராய்ச்சி இங்கு நடைபெற்று வருகிறது நீங்களும் இந்த ஆராய்ச்சியில் பங்கேற்க விரும்பிகிறோம் .

உங்களை சில சிறப்பு பரிசோதனைக்கு உட்படுத்தி அதன் தகவல்களை ஆராய்வோம். அதனால் தங்களது நோயின் ஆய்வரிகையோ அல்லது சிகிச்சையோ பாதிப்பு ஏற்படாது என்பதை தெரிவித்து கொள்கிறேன் .

முடிவுகளை வெளியிடும்போது அல்லது ஆராய்ச்சியின் போதோ தங்களது பெயரோ அல்லது அடையாளங்களோ வெளியிட மாட்டோம் என்பதை தெரிவித்து கொள்கிறோம்.

இந்த ஆராய்ச்சியில் பங்கேற்பது தங்களுடைய விருப்பத்தின் பேரில்தான் நடக்கும். . மேலும் நீங்கள் எந்நேரமும் இந்த ஆராய்ச்சியில் இருந்து பின் வாங்கலாம் என்பதையும் தெரிவித்து கொள்கிறோம்.

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ஆராய்ச்சியாளரின் கையொப்பம் பங்கேற்பாளர் கையொப்பம்

MASTER CHART

STAPLER

S.No.	NAME	AGE	SEX	IP NO	Conditions	Operative time	Bowel sounds	Resumption of oral feeds	Post op Hosp. stay	Incidence of complications
1	selvam	54	male	56871	malignant	240	46	72	3	
2	muniyandi	60	male	29068	Benign	246	48	76	5	Anastomotic leak
3	murugan	45	male	4796	malignant	252	50	80	5	
4	visweswaran	46	male	31021	Benign	264	52	82	4	
5	raman	60	male	31407	malignant	245	48	84	6	
6	selvakumar	52	male	6098	malignant	240	50	80	3	Anastomotic leak
7	perumal	60	male	35949	Benign	265	48	72	2	
8	chellasamy	43	male	32672	malignant	252	46	80	4	
9	boominathan	54	male	38863	malignant	256	48	72	5	Anastomotic bleed
10	gurusamy	56	male	39807	Benign	248	48	80	6	
11	mariyappan	45	male	8665	malignant	256	48	78	2	Anastomotic stricture
12	subramani	62	male	11760	Benign	250	48	78	2	
13	muniyandi	50	male	47294	malignant	264	46	76	3	Anastomotic stricture
14	rengaiah	61	male	48023	Benign	252	48	80	4	
15	sasikumar	55	male	3214	malignant	258	50	82	3	
16	muthu	60	male	10921	malignant	246	46	84	4	
17	mariyammal	57	female	18311	Benign	244	48	80	5	Anastomotic leak
18	mohana	52	female	16606	malignant	268	48	72	3	
19	kannan	55	male	15334	malignant	260	48	80	4	
20	babu	55	male	13090	Benign	255	50	72	4	Anastomotic leak
21	rajamani	55	female	2263	malignant	245	48	80	5	
22	mariyammal	43	female	7587	Benign	252	48	78	2	
23	raja	48	male	56874	malignant	256	46	78	3	
24	gurumoorthy	58	male	23548	Benign	238	48	76	2	Anastomotic stricture
25	rajakannan	44	male	35648	malignant	260	50	80	3	

Hand sewn										
S.no.	**NAME**	**AGE**	**SEX**	**IPNO**	**Conditions**	**Operative time**	**Bowel sounds**	**Resumption of oral feeds**	**Post op Hosp. stay**	**Incidence of complications**
1	kalirajan	44	male	2825	malignant	285	58	86	5	Anastomotic leak
2	rose	50	female	98835	Benign	280	64	88	5	
3	alphoxia	56	female	5132	Benign	290	50	92	4	
4	ganapathyammal	54	female	31190	malignant	302	52	96	6	
5	periyapandi	59	male	32458	Benign	290	64	84	8	
6	vishwa	55	male	34091	Benign	256	50	88	9	Anastomotic leak
7	mahendran	43	male	36097	malignant	268	60	84	4	
8	panchavarnam	46	female	36768	Benign	256	62	90	5	Anastomotic bleed
9	mahendran	50	male	38940	malignant	250	64	94	6	
10	ashok kumar	62	male	8447	Benign	264	58	96	5	
11	manjakalai	60	male	7392	malignant	252	52	88	10	
12	pasupathy	58	male	39048	Benign	258	60	84	6	Anastomotic leak
13	balamurugan	57	male	1752	Benign	258	60	86	6	
14	periyasamy	61	male	3975	malignant	268	62	84	6	
15	manikandan	60	male	10651	Benign	268	60	88	4	
16	senthilnathan	44	male	11141	Benign	264	62	90	5	Anastomotic stricture
17	sundarajan	55	male	11713	malignant	270	64	82	6	
18	subbaiah	55	male	11069	Benign	272	60	96	5	
19	marimuthu	49	male	2208	malignant	288	58	88	9	
20	rakku	51	female	6130	Benign	256	56	84	8	
21	mahendran	43	male	2568	malignant	276	54	86	7	
22	Panju	46	female	6541	Benign	310	58	88	6	
23	Rajavel	50	male	26589	Benign	268	60	90	7	Anastomotic bleed
24	Kumar	56	male	45875	Benign	290	52	92	8	
25	Rajesh	47	male	12365	Benign	278	58	94	9	

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MADURAI, TAMILNADU, INDIA -625 020
(Affiliated to The Tamilnadu Dr.MGR Medical University, Chennai, Tamil Nadu)

ETHICS COMMITTEE CERTIFICATE

Name of the Candidate	:	Dr.K.Arunsenthilnathan
Course	:	PG in MS., General Surgery
Period of Study	:	2016-2019
College	:	MADURAI MEDICAL COLLEGE
Research Topic	:	A Comparative study of efficacy of staplers vs hand sewn anastomosis in bowel surgeries in GRH, Madurai
Ethical Committee as on	:	21.11.2017

The Ethics Committee, Madurai Medical College has decided to inform that your Research proposal is accepted.

Member Secretary

Chairman
Prof Dr V Nagaraajan
M.D., MNAMS, D.M., Dsc.,(Neuro), Dsc (Hon)
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